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EDWARD DRINKER COPE, NATURALIST—A CHAPTER IN THE HISTORY OF SCIENCE.[1]

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I.

Bitter constraint, and sad occasion, dear,
Compels me to disturb your season due;
For Lycidas is dead, dead ere his time,
Our Lycidas, and hath not left his peer.

On the morning of the 13th of April, in a car on my way from a funeral in New York to Washington, a newspaper notice of the death, the day before, of my old friend, E. D. Cope, caught my eye. Shocked by the intelligence, I dropped the paper, and memory recalled various incidents of our long acquaintance.

The threnody of Milton[2] in commemoration of his friend Edward King, also rose to recollection, and the lines just quoted seemed to me to be peculiarly fitted for the great man just dead. He was, indeed, no longer young and had attained his prime,[3] but he had planned work for many years to come,

[1] Address by the retiring President of the American Association for the Advancement of Science at the Detroit Meeting, August 9th. Also printed in "Science," August 13, 1897, and in the "Scientific American Supplement," Aug. 14, 28, Sept. 4, 11, 1897.

[2] Milton, Poems, XVII.

[3] In the extract from Milton's poem, *time* has been substituted for *prime*, and *our* for *young*.

and had well advanced in the execution of some of it. He had truly died before his time and had left no peer; the greatest of the long line of American naturalists was prematurely snatched from science and from friends.

My acquaintance with Cope began in 1859. While looking through the part of the Proceedings of the Academy of Natural Sciences of Philadelphia for the month of April, in which my first paper published by the Academy had appeared, I found one by E. D. Cope "On the Primary Divisions of the Salamandridæ." It seems that the papers by Cope and myself had been passed on by the Committee on Publications on the very same day (April 26th), and appeared in print in juxtaposition. I had not previously heard of the new devotee of science, and read his article with as much interest as my own. A well-equipped man had evidently come upon the field and this was the first of the numerous articles that were destined to appear in an uninterrupted flow for nearly four decades. A few months afterwards I met the author in Philadelphia at the Academy. A young man, nineteen years old, about 5 feet 9 or 10 inches high, with head carried somewhat backwards and of rather robust frame, stood before me. He had an alert, energetic manner, a pronounced, positive voice, and appeared to be well able to take his part in any trouble. His knowledge was by no means confined to herpetology, but covered a wide range of science, and his preliminary education had been good. We afterwards met from time to time in Philadelphia and Washington, and found we had many sympathies in common and some differences.

In one of our first interviews we had quite an argument on the nature of the family group in zoology, resulting from criticisms I had made on the extended scope he had given to that category in the classification of the Salamanders. Another controversy, I remember, had reference to the vertebral theory of the skull. In an article on the venomous serpents, published in the Proceedings of the Academy for 1859, he had defined the group in terms involving the adoption of that theory, and I ventured to dissent from its reality. I had myself been much impressed with it in former days, and when 16 years old

had copied in colors an illustration of Owen's so-called archetype reproduced in Carpenter's Physiology. Subsequently, however, the fact that there was only an approximation to the realization of it in the most specialized of fishes and not at all among the lower or higher vertebrate, with other considerations, turned me from it, and I gave my reasons for dissent to Cope. Ultimately he admitted the force of the argument, and also abandoned the theory at one time so popular in England and America.

Our acquaintance, thus begun in 1859, continued uninterruptedly till death divided us. We rarely met, indeed, that we did not express difference of opinion respecting some subject, but the difference was never of a serious nature, and generally little more than sufficient to enliven intercourse.

II.[4]

The future naturalist was born in Philadelphia on the 28th of July, 1840, and the name Edward Drinker was given to him. He was the descendant of a prosperous line long established in Pennsylvania. His father, Alfred was a man of cultivated literary taste, and did much to train his son's mind in early youth. He had retired from active business and lived in luxurious ease near Germantown,[5] a suburb of Philadelphia. There he had formed an arboretum containing most of the American trees which would thrive in the climate of that region. Amidst such surroundings the youthful Cope grew up.

An active and intelligent interest in Nature became manifest at a very early age. When only about seven years old, during a sea voyage to Boston with his father, the boy is said to have kept a journal which he filled with drawings of "jelly fish, grampuses and other natural objects seen by the way."

[4] I am indebted to a brother in-law of Prof. Cope, Mr. Philip C. Garrett, for fuller information and rectifications of statements made in the original address, which I have utilized in this edition in the form of notes.

[5] According to Mr. Garrett, "in strict accuracy, his father either had not retired from active business or had never been in it, having been and remaining what is called an active partner of H. & A. Cope, though, it must be admitted, a rather inactive one at all times through very poor health. The home in which Edward was reared from early boyhood was not in Germantown, but about a mile east of it on the York road."

When eight and a half years old he made his first visit to the Museum of the Academy of Natural Sciences of his native city; this visit was on the "21st day of the 10th Month, 1848," as entered in his journal. He brought away careful drawings, measurements and descriptions of several larger birds, as well as of the skeleton of an Ichthyosaurus. His drawing of the fossil reptile bears the explanatory legend in Quaker style: "two of the sclerotic plates look at the eye—thee will see these in it."

At the age of ten he was taken upon a voyage to the West Indies.[6] What were the impressions he derived from that voyage we have not been told. But what has been communicated amply justified Professor Osborn in his declaration that "the principal impression he gave in boyhood was of incessant activity in mind and body, reaching in every direction for knowledge, and of great independence in character and action." His school[7] education was mostly carried on in the Westtown Academy, a Quaker institution about 23 miles west of Philadelphia. One of his instructors was Dr. Joseph Thomas, a well known literary worker of Philadelphia and future author of a "Universal Pronouncing Dictionary of Biography and Mythology" (1870), and said to have been an "excellent linguist." Under his guidance Cope obtained a passing knowledge of Latin and Greek. He appears to have had no instruction in any biological science and had no regular collegiate training. He did, however, enjoy the advantage of "a year's study (1858–9) of anatomy and clinical instruction at the University of Pennsylvania," in which the illustrious Leidy was professor of anatomy. But, in the words of his literary executor (Professor H. F. Osborn), "it is evident that he owed far more to paternal guidance in the direct study of nature and to his own impulses as a young investigator than to the five or six years of formal education which he received

[6] Osborn, in *Science*, N. S., V, 706.

[7] Mr. Garrett informs me that Cope's "education appears to have been received at home until 1851; then for two years at the Friends' Select School in Philadelphia; from 1853 to 1856 at West Town, and from 1856 to 1859 by private tuition, and then again at the Select School in Philadelphia.

at school. He was especially fond of map drawing and of geographical studies."

While a school boy he relieved his studies of the classics and the regular course in which boys of his age were drilled by excursions into the fields and woods. Reptile life espepecially interested him, and he sought salamanders, snakes and tortoises under rocks, stones, fallen trees and layers of leaves, as well as in the ponds and streams of his vicinage. The trophies of his excursions were identified from descriptions in the works in which they were treated, as well as by comparison with identified specimens in the museum of the Academy. He early and almost without guidance learned to use the library and collection of the Academy, although he did not become a member until he came of age in 1861.

Cope's first contribution to the Proceedings of the Academy appeared in the part covering April, and was "On the Primary Divisions of the Salamandridæ, with Descriptions of the New Species."[8] In this maiden paper he instituted important modifications of the systems previously adopted in the United States. He soon afterwards catalogued the serpents preserved in the museum of the Academy of Natural Sciences and likewise improved upon the systems previously in vogue. He continued with various papers, describing new species and giving synopses of brief monographs of sundry genera of lizards and anurous amphibians.

For five years his publication was confined almost exclusively to the reptiles and amphibians. (The continuity was only interrupted once in 1862, when he described a new shrew caught by himself in New Hampshire.)[9] Not until 1864 did he begin to extend his field. In that year he described various fishes and a supposed new whale, and gave his first contribution to paleontology in the description of the stegosaurian amphibian called *Amphibamus grandiceps.* But although his attention had become thus divided, he never lost his interest in

[8] Proc. Acad. Nat. Sci. Phila., 1859, pp. 122-128.

[9] An unentitled communication upon certain cyprinoid fish in Pennsylvania was published in the Proceedings of the Academy of Natural Sciences early in 1862 (Proc. 1861, p. 522-524); It is not included in the list of Cope's papers in the catalogue by the Royal Society.

herpetology and continued to the end of his life to devote much attention to that department. His studies extended to every branch of the subject, covering not only specific details and general taxonomy, but also the consideration of anatomical details, the modifications of different organs, geographical distribution, chronological sequence, genetic relations and physiological consequences. So numerous were his memoirs, so entirely did he cover the field of herpetology, and so marked an impression did he make on the science, that he was well entitled to apply to himself the boast of the Vergilian hero, "*Pars magna fui.*"

In his earliest essays he manifested the independence and critical spirit which were so characteristic of him later. One knowing all the circumstances of the case may be amused in coming across a passage expressed in the tones of a veteran published by him when 20 years old: " In proposing the name Zaocys * * * we are giving expression to an opinion *long held by us* as to the unnatural association of species in the so-called genus *Coryphodon* * * *. In it we find cylindrical terrestrial species united with compressed subarboricole species, upon a peculiarity whose value as an index of nature appears to us entirely imaginary. The very nature of the *coryphodontian* type of dentition, as distinguished from the *isodontian* and *syncranterian*, would lead us to infer its inconstancy; " and so on.[10] Bold as was the criticism of such herpetologists as Duméril, Bibron and Günther, it was justified by the facts, and the young author's conclusions have received the endorsement of the best succeeding herpetologists, including even the latest author criticised.

[10] Proc. Acad. Nat. Sci., Phila., 1860, p. 563.

In 1863 he paid a visit to Europe, partly for the benefit of his health which had suffered from overwork, and partly for the purpose of seeing the great museums of England, France, Holland, Austria and Prussia. Notwithstanding his ailments, he made good use of his time abroad and systematically examined the collections of reptiles in the chief centers of science. He did not even restrict his studies to herpetology, but extended them to various other subjects.

On his return from Europe in 1864, he was appointed professor of natural science in Haverford College, an institution chiefly supported by Quakers, but retained the position only three years. During this time, in 1865, he married Miss Annie, daughter of Mr. Andrew Pim, of Chester County, Pa.

In and after 1864, too, he enlarged the range of his studies and publications and also extended them to ichthyology, mammalogy and paleontology. He had always been interested in the philosophical aspects of science and early adopted the conception of descent with modifications to account for the variations of animals and the differentiation into species and higher groups, and in 1869 began to give expression to his peculiar views.

On the death of his father[11] he became heir to a considerable fortune. Part of this was invested in mines which for a short time gave promise of good returns, but, it is said, the majority of the stock was held by others, and owing to the incapacity of superintendents and the operations of the controlling stockholders, he losts his interests. While in the enjoyment of his fortune he spent large amounts in collections and personally conducted or sent out expeditions to various places. One of the most important was sent to South America. He filled a large house from cellar to topmost story with his collections and resided in an adjoining one.

In 1871 he conducted an expedition to Kansas and especially investigated the Cretaceous beds of that State and collected their fossils. In 1872 and 1873 he became connected with the U. S. Geological Survey, and for the fossils visited Wyoming in the former year and Colorado in the latter. In 1874 he joined the survey under the command of Lieut. Wheeler, of the Engineers, and explored New Mexico.

The collections made during these expeditions were large, and the unwearied industry and energy, as well as cares, of Cope were rewarded with many well-preserved fossils. These were described in many communications to the Academy of Natural Sciences and the American Philosophical Society, and later in large volumes published by the general government

[11] Cope's father died December 4, 1875.

as reports of the respective surveys with which he was connected.

The various investigations thus opened were continned through the succeeding years. His collections continued to grow in spite of reduced means. He refused even to sell portions for which he was offered liberal sums, and, at the cost of personal discomfort, held on to them and made his home, for much of the time, in the midst of them, having sold his residential house but kept his museum.

In 1878 he purchased the rights of the proprietors of the AMERICAN NATURALIST and removed it to Philadelphia. Professor Packard, one of the original proprietors, cooperated with him in the editing of it for some years, and he was also assisted by various eminent specialists. In this journal numerous articles of all kinds, including reviews and editorial comments, were published by him. His last words appeared in numbers issued after his death, the leading article in the number for June having been written shortly before his death; it treats of the remarkable mammals of South America, known as Toxodontia.

In 1886 he received an appointment to a chair in the University of Pennsylvania and became professor of geology and paleontology. Such a man naturally awakened the interest of apt pupils, and he was a facile and entertaining lecturer. From the stores of a rich memory he could improvise a discourse on almost any topic within the range of his varied studies. His views were so much in advance of those in any text-book that for his own convenience, no less than for the benefit of his pupils, he felt compelled to prepare a "Syllabus of lectures on geology and paleontology," but only "Part III, Paleontology of the Vertebrata," was published. It appeared in 1891, and is still a valuable epitome of the classification of the vertebrates, recent as well as fossil, giving in dichotomous tables the essential characters of all the groups above families and also the names of all the families. His own industry and investigations did much to render this antiquated in even six years, and a new edition of work became necessary. "Upon the Tuesday preceding his death he sent to the press an ela-

borate outline of his University lectures containing his latest ideas of the classification of the Vertebrata.[12]

The enormous mass of publications constantly flowing from his own pen might lead one unacquainted with the author to suppose that he was probably a recluse, but there were few men of his intellectuality who were less disposed to seclude themselves. He enjoyed and gave enjoyment to intellectual company and was a brilliant conversationalist. He was especially fond of academical meetings and was an unusually frequent attendant at the meetings of the American Association as well as of the National Academy of Sciences. His election to the Presidency of the American Association was highly esteemed by him and doubtless his address would have been a notable one.

In February (1897) Cope's health became seriously affected by a nephritic disorder, which, it is said, "might possibly have been remedied by a surgical operation," but to this he would not submit.[13] Notwithstanding failing health, he continued active almost to the last. Finally, the insidious disease invaded his entire system and he died on the 12th of April, in the room he had long used as a study, surrounded by the objects of his life-long attentions.

Such were the chief episodes of Cope's individual life; the facts known are few, and the record belongs rather to his family than to us. But Cope's real life was in his work, and to the consideration of that work we may now proceed. Let us adopt the order in which he took up the subjects of his investigations and successively look into his contributions to herpetology (III), ichthyology (IV), mammalogy (V) and paleontology (VI); we may then examine his philosophical views and especially those relating to evolution (VII); finally we may attempt to forecast the position he is destined to enjoy in the history of science (VIII). To know him as he was we must

[12] Osborn in *Science*, May 7, p. 705.

[13] According to Mr. Garrett, "as regards the disorder of which he died, it was cystic, not nephritic, the *post-mortem* showing little disease of the kidneys. The surgical operation he intended to undergo, but became too ill before it was accomplished."

recognize his weakness as well as his strength. He himself has wished this and has asked in the spirit of the Moor:

> Speak of me as I am; nothing extenuate,
> Nor set down aught in malice.

III.

The extent of Cope's contributions to herpetology have been referred to. Herpetology was his first love and continued to be the favorite branch of science to his life's end. His impress on it was, in some respects at least, greater than on any other of the sciences he cultivated, and doubtless the systems he introduced, with some modifications, will be the most lasting. He found herpetology an art; he left it a science: he found it a device mainly for the naming of specimens; he left it the expression of the coordination of all structural features. The reformations he effected in the classification of the anurous amphibians and the saurian reptiles were especially notable.

The anurans had been chiefly differentiated in groups on account of the most superficial characters. Such were the modes of fixation of the tongue or its absence, the development of disk-like expansions of the tips of the toes or simply attenuated toes, and the presence or absence of teeth in a jaw. Cope proceeded to investigate the group in an anatomical manner and reached entirely new conclusions. He found that important differences existed in the structure of the sternum, and especially in the connection of the lateral halves. In the common toads and tree toads of Europe and North America the so-called clavicle and coracoid of each side are "connected by a longitudinal arched cartilage which overlaps that of the opposite side," while in the common frogs the clavicles and coracoids of both sides are connected by a single median cartilage. The former type is now known as the arciferous and the latter as the firmisternal. Although Cope was the first to appreciate the significance of those characters, he did not at once fully realize their morphological value, the name Arcifera having been originally applied by him only to types of that group having teeth. Ultimately he did so, and his views have stood the test of time and the latest critical investigations.

He also found that the characters so revealed served to fix the places in the system of the groups in question. In their early stages the Firmisternials (or frogs and their relations) have the shoulder-girdle moveable, and thus resemble the Arcifers (toads, etc.), which have the opposite halves movable during their whole life time; thus it became evident that the latter are the lowest or most generalized forms, and the former more advanced and higher in the system. The development of teeth, which had been supposed by the earlier systematists to be of paramount value, and which Cope, following in their footsteps, had also originally unduly valued, has been found to be of quite subordinate importance.

The lizards were also in former times distributed into families and other groups on account of variations in superficial or external characters, such as the form of the tongue, the arrangement of the scales and the development of legs and feet. Cope dissected examples of all the types he could obtain and found that such superficial characters were often misleading, and he proceeded to arrange them with reference to the preponderance of all characters. The structure of the cranium especially was analyzed, and the variations and concordances in the development of various bones were tabulated. These characters were supplemented by others derived from the vertebræ, the shoulder girdle, the teeth, the tongue and the pholidosis. Familiarity with his subject enabled him almost instinctively to assess the relative values of the different characters, and he obtained fitting equations which resulted in a system which has received the approbation of the most competent judges to the present time.

The extent of Cope's influence on herpetology may be to some extent inferred from the catalogues of the richest collection of reptiles and amphibians in existence—the British Museum's. Descriptive catalogues of both the Anurans and Saurians have been published at different times. In the early catalogues are adopted the views current at the dates of publication—1845 for the lizards; 1858 for the batrachians. New editions were published many years later and the systems of Cope were adopted with slight modifications. In his catalogue

on the *Batrachia salientia* Mr. Boulenger, the author, remarked that it appeared "undeniable that the principles of classification laid down by Mr. Cope are more in accordance with the natural affinities of the genera of tailless Batrachians than those employed by other authors; this is amply proved by all we know of their geographical distribution, development and physiology."

In an article[14] published in advance of his catalogue of the lizards, Boulenger states that the old classifications are, "on the whole, as unnatural as can be" and that, "like Cope, whose lizard families I regard as the most natural hitherto proposed, I shall lay greater stress on osteological characters and on the structure of the tongue."

It was a long time, however, before Cope's views became popular. Even anatomists of repute refused to follow him. One[15] of them, for example, admitted that "skeletal characters are, indeed, most valuable ones in leading us to detect the deepest and truest affinities of vertebrates, but [he urged] these affinities once found, it is very desirable that zoological classification should not, if it can possibly be avoided, *repose* upon them only, but rather on more external and more readily ascertainable characters." He, therefore, ventured "to propose a classification derived from that of Dr. Günther."

Cope replied[16] by a fierce review of the work of Dr. Günther, and concluded with the utterance that such views "will only interfere with the progress of knowledge if sincerely held and believed."

But such views were evidently sincerely believed and they did retard the progress of science. An eminent Russian herpetologist objected to the use of anatomical characters. He especially protested against those employed by Boulenger after Cope to the grouping of the lizards, and Mr. Boulenger considered it incumbent on himself to defend the practice of using such characters;[17] he aptly replied that the use of "purely ex-

[14] Synopsis of the families of existing Lacertilia. Ann. and Mag. Nat. Hist. (5), XIV, 117.

[15] Mivart in Proc. Zool. Soc. London, 1869, p. 2-1.

[16] Cope in Am. Journ. Sci. (3), I, p. 203.

[17] Boulenger in Ann. and Mag. Nat. Hist. (5), XIX, 385.

ternal characters * * * does not meet the requirements of modern science," and that classifications are not made simply "for the convenience of beginners."

At last, however, the principles of classification adopted by Cope have become generally accepted, and doubtless this was in no small degree hastened by their application to all the amphibians and reptiles by Boulenger.

Cope's attention to the extinct reptiles was excited by the examination and consideration of a Carboniferous lizard-like amphibian which he was requested in 1865 to report upon. It was a new species which he named *Amphibamus grandiceps* and considered to be the type of a new order to which the name Xenorachia was applied, but which he subsequently referred to the new comprehensive order Stegocephali.

He sought for specimens of the extinct species with as much enthusiasm as he had for the recent. Extinct and living he considered together and light was mutually reflected from the two to guide him in the perfection of the entire system. In 1869 he gave expression to the results of his studies in a well illustrated "Synopsis of the Extinct Batrachia, Reptilia and Aves of North America." This was supplemented in 1874 by addenda and a "Catalogue of the air-breathing Vertebrata from the coal measures of Ohio."

A rich field was opened to him in 1877, when he received the first instalment of reptilian remains from Texas, which were at first considered to be of Triassic age, but subsequently determined to be Permian. Successive instalments of amphibian as well as reptilian skeletons enriched his collection, and his investigations revealed a new and wonderful fauna rich in species and often differing widely from any previously known. These were described in many articles. The results for the amphibians were summarized in 1884 in a memoir on the "Batrachia of the Permian period of North America."

The Permian amphibians were found to vary much in the composition of their backbones. Instead of having single centra arranged in a continuous row as in existing Vertebrates, they had distinct bones on which were devolved portions of the functions fulfilled by the centra of higher Vertebrates.

Some had "the vertebral bodies represented by three segments each, a basal intercentrum and two lateral pleurocentra;" these were named "Ganocephali" and "Rhachitomi." Some "differ remarkably from all other Vertebrata in having between the centra another set of vertebral bodies, so that each arch has two corresponding bodies;" these were called "Embolomeri."

In tracing the development of these bones, Cope came to the conclusion that they were only partially represented in higher or more specialized types; they did not become consolidated, but one or the other became reduced and finally lost or at least greatly atrophied. In the living amphibians the vertebral centra are homologous only with the intercentra, while, on the contrary, the centra of the reptiles, birds and mammals are represented by the pleurocentra of the Rhachitomes.

The studies of Cope on those classes which had earliest attracted his attention were more nearly completed than for any others. Many years ago he had contemplated the publication of monographs of the amphibians and reptiles of North America and happily he had at last finished his work.

In 1889 his monograph of the "Batrachia of North America" was given to the world as a Bulletin of the United States National Museum (No. 34). It forms a goodly volume of 525 pages illustrated by 81[18] plates and 120 figures inserted in the text. No large country has a more elaborate and scientific exposition of the class than is given in this volume. A synopsis is furnished of all the families and genera wherever found, and detailed descriptions are supplied for all the groups and species represented in the zoological realm of North America, 31 genera and 107 species are recognized, and of these Cope had first made known about a quarter, 7 of the genera and 27 of the species having been described by himself.

Shortly before his death, and during his last visit to Washington he delivered to the National Museum the report on all the reptiles of North America which he had been long preparing. This was prepared on the model of his "Batrachia of North America," but will, of course, be a much larger work,

[18] The last plate is numbered 86, but five were cancelled, 80, 81, 82, 84 and 85.

inasmuch as there are nearly three times as many reptiles as batrachians.[19] His last elaborate memoirs dealt with special anatomical features of the serpents and lizards, which he examined with the view of perfecting the system of those groups.

IV.

In 1864 Cope[20] became especially interested in the fresh-water fishes of the United States, and then as well as in succeeding years published enumerations and descriptions of many species. His first papers in 1864 and 1865 were "On a blind Silurid from Pennsylvania" and a "Partial catalogue of the cold-blooded Vertebrata of Michigan;" in 1868 he published "On the distribution of fresh-water fishes in the Allegheny region of southwestern Virginia," and in 1869 appeared a "Synopsis of the Cyprinidæ of Pennsylvania." In addition to these, various minor papers were published, and in some of them marine forms were considered.

When in Europe he had purchased a large collection of skeletons of fishes from all parts of the world prepared by Professor Joseph Hyrtl, of Vienna, one of the most skillful practical anatomists of the day. He had a number of other skeletons made to represent missing types. With these as a basis he proceeded to recast the classification of fishes. The first contribution to the subject was embodied in an introductory chapter of his "Contribution to the Ichthyology of the Lesser Antilles," published early in 1871.

The same chapter, with the same title, "Observations on the Systematic Relations of Fishes," but with some modifications and additions, was later published in the Proceedings of the American Association for the Advancement of Science for 1871. This was a notable paper and replete with original observations of value. It was not, however, up to the standard of his work on amphibians and reptiles. The subject, indeed, was too vast and only a superficial examination was made of

[19] Cope's monograph of the reptiles will not include the tortoises, those having been left to Dr. G. Baur to monograph.

[20] A short unentitled communication (before alluded to) was pulbished as early as 1863.

special parts. It was not a classification based on the examination of the entire structure, but rather an exposition of the development of a few particular characters, which more experience subsequently convinced him were of less value than he had supposed. Nevertheless, in some respects the proposed classification was much in advance of those previously adopted, and useful hints were given for the further improvement of the system.

Later Cope followed up this attempt at the reformation of the ichthyological system with several others especially treating of extinct types. One of them, "On the classification of the extinct fishes of the lower types," was published in the Proceedings of the American Association for 1877. The results of his studies were summarized, in 1889, in "A synopsis of the families of Vertebrata," and two years afterwards (1891) with modifications, in an article "On the non-actinopterygian Teleostomi." These results were very valuable, and attention was for the first time directed to the importance and morphological significance of the skeletal fin structures of the ancient fishes long confounded under the name of Ganoids. Instead of this single order (or subclass) of the old systematists, he named four superorders of the Teleostomi or true fishes, and recognized seven orders, including the old ganoids after eliminating the Lepidosteids and Amiids, which were referred to the Actinopterygians. Only two of the seven orders are represented by existing forms—one (*Cladistia*) by the bichirs of Africa, and the other (*Chondrostei*) by the sturgeons.

His work on the extinct fishes was incomparably better than any that had been done before in the United States. He far surpassed all his predecessors, not only by his knowledge of morphological details manifest in the extinct as well as living forms, but by his keen philosophical instinct and taxonomic tact. But this philosophical instinct was sometimes at fault, and occasionally he indulged in the wildest speculations, for which he has, not unjustly, been taken to task. Yet even his blunders were the result of the facility of his mind in seizing and adapting the latest utterances of science. One notorious case may be given. The great Russian embryologist Kowal-

evsky published a memoir sustaining the thesis that the Tunicates were members of the vertebrate phylum, and that the larval stage of most of the species had the homological equivalent of the backbone of the true vertebrates. Cope foresaw the morphological consequences of this view and sought the vertebrates nearest the Tunicates. He settled upon some strange forms of the Silurian and Devonian times known as Pteraspids and Cephalaspids. They were the earliest known of vertebrates and, therefore, likely to be the most primitive in structure. Most of them had a shell-like encasement, composed of bone-like plates. He happened to find illustrations of the living *Chelyosoma*, a true Tunicate, having a system of plate-like indurations of the integument, somewhat similar in appearance to those of some of the ancient fishes. It was assumed that this mere superficial similarity indicated genetic relationship. To those acquainted with the structure of *Chelyosoma* this approximation seemed strange indeed; its anatomy was known and the form is simply a well marked relation of the typical Ascidiids, but highly specialized by the development of integumentary plate-like horny indurations. Histologically and otherwise they were very different from the plates of the extinct armored vertebrates. Cope's guess was simply the result of the tendency to jump at conclusions which he was constantly obliged to curb, and unfortunately he rushed into print before he had time to think. He soon reconsidered the case with calmer mind, and abandoned his hypothesis. Few men were ever more willing to reconsider evidence and retrace false steps than was he.

In spite of errors of detail and somewhat hasty generalization the ichthyological labors of Cope were unusually valuable contributions to science, and the progress of ichthyology has been much accelerated, not only by these labors, but by the investigations they challenged.

V.

Cope's attention was early drawn to the mammals. His first published article (1863) was a description of a supposed new Shrew found in New Hampshire, and in 1865 he described

various cetaceans. In 1868 he began the collection and investigation of the fossil mammals of the western territory, and thenceforward devoted the larger share of his attention to the description and restoration of the numerous new species which he from time to time brought to light. The previous investigators of the extinct mammals of America had almost exclusively confined themselves to descriptions and illustrations of the crania and dentition, but a new era was introduced when Marsh and Cope sent out exploring expeditions or themselves collected. No parts of skeleton were neglected; all were collected. Gradually the numerous bones from different parts of the skeleton were identified, and finally many of the beasts of old were resurrected into skeletons almost as complete as those just divested of muscles.

The discoveries resulting from such thorough work quite modified or even overturned old conceptions. It became evident that there was a great contrast between the development of the mammals and that of the invertebrates, and even, though in a less degree, of fishes. It appeared that there was a much more rapid process of evolution for the mammals than for the lower classes. All the mammals of the oldest of the Tertiary periods were strange and very unlike those of recent times, and no descendants of even the same families lived to be the contemporaries of civilized man. The views of the founder of vertebrate paleontology were also to a considerable extent subverted. Cuvier taught that there was always a coordination between the various systems of the animal frame and that from the remains or impress of one part the approximate structure of the other parts could be inferred. He even pushed this doctrine to such an extreme that he overlooked some obvious counter facts. One such case is so remarkable because it originated with Cuvier and was endorsed by Huxley[21] that it is worthy of mention here, and Huxley's introduction to it and translation of it may be given. Huxley himself protests against the too literal application of Cuvier's law, and recalls Cuvier's own reserve:

[21] Huxley: "Introduction to the Classification of Animals," 1869, in first chapter "On Classification in General."

Cuvier, the more servile of whose imitators are fond of citing his mistaken doctrines as to the nature of the methods of paleontology against the conclusions of logic and of common sense, has put this so strongly that I cannot refrain from quoting his words.[22]

"But I doubt if any one would have divined, if untaught by observation, that all ruminants have the foot cleft, and that they alone have it. I doubt if any one would have divined that there are frontal horns only in this class; that those among them which have sharp canines for the most part lack horns.

However, since these relations are constant, they must have some sufficient cause; but since we are ignorant of it, we must make good the defect of the theory by means of observation. It enables us to establish empirical laws, which become almost as certain as rational laws, when they rest on sufficiently repeated observations; so that now, whoso sees merely the print of a cleft foot may conclude that the animal which left this impression ruminated, and this conclusion is as certain as any other in physics or morals. This footprint alone, then, yields to him who observes it, the form of the teeth, the form of the jaws, the form of the vertebræ, the form of all the bones of the legs, of the thighs, of the shoulders, and of the pelvis of the animal which has passed by. It is a surer mark than all those of Zadig."

The first perusal of these remarks would occasion surprise to some and immediately induce a second, more careful reading to ascertain whether they had not been misunderstood. Some men, with much less knowledge than either Cuvier or Huxley, may at once recall living exceptions to the positive statements as to the coordination of the "foot cleft" with the other characters specified. One of the most common of domesticated animals—the hog—would come up before the "mind's eye," if not the actual eye at the moment, to refute any such correlation as was claimed. Nevertheless, notwithstanding the fierce controversial literature centered on Huxley, no allusion appears to have been made to the lapsus. Yet every one will admit that the hog has the "foot cleft" as much as any ruminant, but the "form of the teeth" and the form of some vertebræ are quite different from those of the ruminants, and, of course, the multiple stomach and adaptation for rumination do not exist in the hog. That any one mammalogist should make such a slip is not very surprising, but that a second

[22] Ossemens fossiles, ed. 4^{me}, tome, 1^{r}, p. 184.

equally learned should follow in his steps is a singular psychological curiosity.

I need scarcely add that the law of correlation applied by Cuvier to the structures of ruminants entirely fails in the case of many extinct mammals discovered since Cuvier's days. Zadig would have been completely nonplussed if he could have seen the imprint of an Agriochœrid, a Uintatherid or a Menodontid.

I have given this quotation for two reasons: first, to indicate how the increase of our knoweldge has revolutionized old conceptions; and second, to show how even the ablest of men may stumble.

Cope has been much criticised for the mistakes and false generalizations he made. Unquestionably he did make many. But error seems to be inseparable from investigation, and if he made more than the other great masters he covered more ground and did more work. He was also, it must be admitted, more hasty than some others in that he availed himself of the more frequent means of publication he enjoyed.

The great merit of Cope's work on mammals is that he always considered the old and new—the extinct and recent—forms together. He refused to be bound by consistency or by precedent, either set by himself or others. Fresh discoveries opened new vistas to him, and he modified his views from time to time and as often as he received new evidence.

He introduced many new families in the system and sought to improve the system by the comparison of all the elements of the skeleton. He came to the conclusion that the affinities of the ungulate quadrupeds were best expressed by the manner of articulation of the bones of the carpus and tarsus; he associated those having the "carpal and usually tarsal bones in linear series" in a great order which he called Taxeopoda, and contrasted them with the Proboscidea and typical Ungulata, which he named anew Diplarthra. In the Taxeopoda he gathered many extinct families and associated with them forms of the existing fauna known as the Hyracoidea, Daubentonioidea, Quadrumana and Anthropomorpha. I cannot altogether assent to this collocation inasmuch as I think the

common characteristics of the three groups last mentioned—especially the structure of the brain and the development of the posterior cornua of the ventricles as well as calcarine sulci—justify the old order Primates. Nevertheless an important character was first appreciated in the composition of the podial bones, and fresh insight was obtained into the relations of ancient types.

I can only name a few more of Cope's discoveries in this connection. One was the generalization of "trituberculy," or the original development of three tubercles to molar teeth, and that subsequent modifications of the corresponding teeth were based on this original plan. Another was the remarkable *Phenacodus* of the Eocene, which was considered to be nearly in a line of descent for the Ungulates as well as the series culminating in man and which led him to the conception of the taxeopodous group.

The past history and genealogy of the Camels and their relations were likewise elucidated. In the present epoch only two nearly related types exist separated by half the globe—the true camels of central and northern Asia and the llamas of the Peruvian Andes. Cope revealed numerous species from various Tertiary beds and showed that the type was originally richly developed in America.[23]

VI.

Paleontology, from more than one point of view, may be divided into Invertebrata and Vertebrate. The subjects of the former are generally to be found in an approximately complete condition so far as the exterior is concerned, and early attracted the attention of investigators, often little familiar with recent zoology, and received names. The subjects of the latter—especially the higher types, as mammals, birds and reptiles—are rarely found, except in a fragmentary condition. Special knowledge of osteology, even to its minutest details, is requisite to successfully deal with such remains. Consequently

[23] Prof. Osborn in a recent letter has justly remarked, that "in the mammals I hardly feel you do Cope sufficient justice, his work has been so potent." The exigencies of time and space alone prevented me from doing that justice, and I may remedy that defect later.

the fossil vertebrates of the United States were neglected and left to the few who had cultivated the requisite knowledge to deal with them.

Another reason existed for the tardy attention to Vertebrate paleontology, which continued till nearly the last quarter of our present century in the United States. No deposits containing many fossil vertebrate remains had become known in the east. Zoologists interested in the past and in the genealogy of existing forms lamented the poverty of the United States, which contrasted with the richness of some parts of Europe. It was even thought that there was no hope of finding here such trophies of the past as the beds of the Paris Basin or those of Grecian Pikermi had yielded to European paleontologists. But all this was to be changed. Rumor had long before hinted that numerous skeletal remains could be found in certain parts of the wild west, but the information was very vague. Enough was known, however, to induce Professor Marsh to visit certain deposits of which he had heard. In 1870 he explored an Eocene lake-basin in Wyoming, drained by the Green River, the main tributary of the Colorado, and therein found numerous bones, belonging to almost all parts of the skeleton, of some remarkable gigantic mammals which he called Dinocerata. The results of this exploration interested Cope in the highest degree. He visited the same region in 1872, and thenceforth his attention to the Vertebrate paleontology of the western States and Territories was never interrupted. An intense rivalry arose between Professor Marsh and himself which, in time, it must be confessed, became very bitter. Nevertheless, as in most quarrels respecting facts, investigations were provoked by mutual recriminations which resulted in a more speedy accumulation of data and a more critical examination of those data than would have been likely under less perturbed conditions. Most of those data relate to morphological and anatomical considerations, and therefore belong rather to mammalogy and herpetology than to geology.

The relations of the ancient forms to each other in point of time; to those of other lands, and to those whose remains

were imbedded in other rocks, had necessarily to be investigated. The earliest conclusions of Cope were brought together and published in 1879 in a memoir on "The Relations of the Horizons of Extinct Vertebrata of Europe and North America."[24] He attempted therein to synchronize, or rather, homotaxially correlate the various ancient faunas of North America and "West Europe" from the "Primordial" to the "Pliocene." Naturally the greater part of the memoir was devoted to the consideration of the Tertiary divisions; of these he admitted for the American faunas six primary divisions, and four of these were dichotomously subdivided. Of the primary divisions three were referred to the Eocene, one (White River) to the Oligocene, one (Loup Fork) to the Miocene, and one to the Pliocene. The exposition thus made represents views not very different from those now held, although, of course, modifications in details have since been necessary.

The evolution of the various animal, and especially mammalian types, were also continually the subject of Cope's researches, and he attempted to trace the passage from those of the most ancient periods to those of later ones.[25]

VII.

Cope was not satisfied with the study of morphological details or simple taxonomy. He aspired to know how animals came into existence; why they varied as they did, and what laws determined their being. His was an eminently philosophical mind, but at the same time with a decided tendency to metaphysical speculation. In one of his earliest papers he manifested this tendency aud it persistod through life. It is with much hesitation that I venture to give an exposition of his most salient views, for I must confess I do not altogether like his philosophy and am able to subscribe to it only in part.

[24] Bull. U. S. Survey Terr., V, 33–54.

[25] I have been reminded by Prof. Osborn of Cope's "discovery of the Puerco—Cope's greatest geological achievement—which Prof. Marsh still fails to recognize; also the definition of the John Day and Deep river beds," Prof. Osborn adds, that "practically the whole fauna of the Wasatch is also Cope's." I recognized these facts, but, as in herpetology and ichthyology, was obliged to limit my address and to refrain from going into details.

I cannot but wish that one of his numerous disciples could have been chosen for this task. But I must not pass it by, for it is the most characteristic feature of Cope's work and the one he most esteemed.

Cope began his public scientific career, it will be remembered, in the same year in which Darwin's long studies had fructified into his "Origin of Species."

As was quite natural with his keen instincts, Cope early adopted the doctrine of transmutation of species and recognized the truth that all the animals of the present epoch are descendents from those of past times with modifications which separate them as species, and eventually as representatives of genera, of families and orders differing from the earlier ones as we retrace the the steps of Time farther and farther back. He was not, however, satisfied with Darwin's theory, and denied that natural selection was a sufficient factor for differentiation. He would not admit that animals were passive subjects and that the slight variations which were manifested in the progeny of species were sufficient to enable Nature to select from and to fit for future conditions. He contended that the volition and endeavors of an animal had much to do with future progeny as well as its own brief life. In short, he claimed that characters acquired by animals through their own efforts or forced on them by various external agencies or accidents might be transmitted to their offspring. He further, first in a chapter in his "Synopsis of the Cyprinidæ of Pennsylvania," outlined, and later, in "The Origin of Genera," he elaborated, a peculiar theory characterized mainly by what he called (with Professor Hyatt) "the law of *acceleration* and *retardation*" in development. Darwin complained that he could never understand this law, and Cope complained that Darwin had not stated his views correctly in an attempted abstract. I therefore give Cope's views, restated in his own language, summarizing them years afterwards. "The following doctrines," he says, were taught:"

First, that the development of new characters has been accomplished by an *acceleration* or *retardation* in the growth of the parts changed. This was demonstrated by reference to a class of facts, some of which were new, which gave ground for the establishment of the new doctrine.

Second, that of *exact parallelism* between the adult of one individual or set of individuals and a transitional stage of one or more other individuals. This doctrine is distinct from that of inexact parallelism which had already been stated by von Baer. And that this law expresses the origin of genera and higher groups, because,

Third, they can only be distinguished *by single characters* when all their representatives come to be known.

Fourth, that genera and various other groups have descended, not from a single generalized genus, etc., of the same group, but from corresponding genera of one or more other groups. This was called the doctrine of *homologous groups.*

Fifth, the doctrine that these homologous groups belong to different geological periods, and,

Sixth, to different geographical areas, which, therefore, in some instances, are,

Seventh, related to each other in a successional way like the epochs of geological time.

Of these doctrines it may be observed that the first and second are now the common property of evolutionists, and are recognized everywhere as matter of fact. The names which I selected to express them have, however, only come into partial use. The author believes that, although the doctrine was vaguely shadowed out in the minds of students prior to the publication of this essay, it had not previously been clearly expressed, nor been reduced to a demonstration. Of the truth of the doctrine the author is more than ever convinced, and he believes that paleontological discovery has demonstrated it in many instances, and that other demonstratious will follow. The fourth proposition (that of homologous groups) is now held as a hypothesis explaining the phylogeny of various groups of animals. For the descent of one homologous group from another, the term *polyphyletic* has been coined. It remains to be seen whether the doctrine is of universal application or not. That homologous groups belong to different geological horizons, as stated under the fifth head, has been frequently demonstrated sincs the publication of the essay. That the sixth proposition is true in a certain number of cases is well known, and it follows that the seventh proposition is also true in those cases. The latter hypothesss, which was originally advanced by Professor Agassiz, is, however, only partially true, and the advance of paleontological study has not demonstrated that it has had a very wide application in geological time.

A proposition which was made prominent in this essay was that the prevalence of non-adaptive characters in animals proves the inadequacy of hypotheses which ascribe the survival of types to their superior adaption to their environment. Numerous facts of this kind undoubtedly in-

dicate little or no activity of a selective agency in nature, and do point to the existence of an especial developmental force acting by a direct influence on growth. The action on this force is the acceleration and retardation appealed to in this paper. The force itself was not distinguished until the publication of the essay entitled "The Method of Creation" [1871], where it was named growth-force or bathmism. The energetic action of this force accounts for the origin of characters, whether adaptive or non-adaptive, the former differing from the latter in an intelligent direction, which adapts them to the environment. The numerous adaptive characters of animals had by that time engaged the attention of the author, and he found that they are even more numerous than the non-adaptive. Some of the latter were accounted for on the theory of the "complementary location of growth-force.

We can only consider the "law of acceleration and retardation." Again it behooves us to seek his own definition:

a. The succession of construction of parts of a complex was originally a succession of identical repetitions; and grade influence merely determined the number and location of such repetitions.

b. Acceleration signifies addition to the number and location of such repetitions during the period preceding maturity, as compared with the preceding generation, and *retardation* signifies a reduction of the number of such repetitions during the same time.[26]

His meaning may best be inferred from his application to mankind. This was done in the following terms in 1872:[27]

Let an application be made to the origin of the human species. It is scarcely necessary to point out at the start the fact, universally admitted by anatomists, that man and monkeys belong to the same order of Mammalia, and differ in those minor characters, generally used to define a "family" in zoology.

Now, these differences are as follows: In man we have the large head with prominent forehead and short jaws; short canine teeth without interruption behind (above); short arms and thumb of hand not opposable. In monkeys we have the reverse of all these characters. But what do we see in young monkeys? A head and brain as large, relatively, as in many men, with jaws not more prominent than in some races; the arms not longer than in the long-armed races of men, that is, a little beyond half way along the femur. * * * At this age of the individual the distinctive characters are therefore those of *homo*, with the exception of the opposable thumb of the hind foot, and the longer canine tooth. * * *

[26] Proc. Am. Phil. Soc., 1871; Origin of the Fittest, p. 182.

[27] Penn. Monthly Mag., 1872; Origin of the Fittest, p. 11, 1887.

Now, in the light of various cases observed, where members of the same species or brood are found at adult age to differ in the number of immature characters they possess, we may conclude that man originated in the following way: that is, by a delay or retardation of growth of the body and fore limbs as compared with the head; retardation of the jaws compared with the brain case, and retardation in the protrusion of the canine teeth.

There is a good reason for thinking that fallacy is involved in this argument, and that quite a different interpretation should be put on the evolution of charasters in question. It is not the fore limbs that are retarded in man, but the hind limbs have become enlarged (compare the adult and the infant). There is not retardation, of the jaws, but a special teleological adaptation. Man has, for the most part, at least, discontinued the use of his teeth for war-fare, and, as a result of diminished use, the canines have become reduced and the diastemata of the dental series obliterated. The brain has grown after birth and become enlarged, and, as a consequence, the brain case has extended forward—the reverse of what occurs in the apes. Concomitantly with the diminished use of the teeth and jaws, the masseter and temporal muscles have become reduced, and the sagittal and lambdoidal ridges have consequently become atrophied. The ecarinate rounded voluminous calvarium is the result.

It has been claimed that the young of higher species "are constantly accelerating their development." In man, however, development is retarded, inasmuch as infancy and juvenility are prolonged far beyond the periods observed in our simian relatives.

Such examples as this give cause to believe that the "law of acceleration and retardation" has been at least unduly extended. Acceleration and retardation are, however, to a large extent, terms which express facts of evolution; whether the word law is applicable may depend on the meaning one gives the word.

The transmission of acquired characters was one of the accepted and most cherished dogmas of Cope, and the belief in transmissibility of such characters is an essential of the ereed

of so many who have become his followers in America that a special school came into existence known as the Neo-Lamarckian and also as the American School. My own prejudices have inclined me to that school. Nevertheless, when I have divested myself of such prejudices as well as I could, I have been compelled to admit that the evidence of the heredity of acquired characters was rather weak. There was, indeed, evidence for, as well as against, but that against the doctrine of the transmissibility of acquired characters seems to be the most weighty.

It is to be understood that the acquired characters considered in this connection are such as have been developed during post-natal life as a result of endeavors of the animal or of the influence of external agencies. The evidence presented has been mostly in support of the contention that the characters acquired have been directly inherited by offspring, and consequently the transition from the form not possessing the character to one having it is rapid. The evidence adduced has not been conclusive, to say the least. There is, apparently, a germ of truth in the proposition that acquired characters are transmitted, but in a modified sense, and the case has been weakened rather than strengthened by the evidence offered.

The evidence for inheritance of acquired characters was frequently given by Cope, and in his last published work—"The Primary Factors of Organic Evolution"—he marshalled the testimonies of many witnesses with his accustomed skill. He evoked "evidence from embryology," "evidence from paleontology," "evidence from breeding;" he considered the "characters due to nutrition," "characters due to exercise of function," "characters due to disease," "characters due to mutilation and injuries" and "characters due to regional influence;" he inquired into "the conditions of inheritance," and he fought against the "objections to the doctrine of inheritance of acquired characters." I have gone over all this evidence and yet I have not been convinced that the contention has been sustained that character acquired during the external life of an animal are transmitted. Many cases are alleged to sustain the "inheritance of characters due to mutilation and injur-

ies." Some of these may be considered as mere coincidences; others provoke skepticism for one reason or other. To discuss them would be out of place here. But at least we may meet evidence with counter-evidence.

On the one hand, all the data and experiments recapitulated in the cases enumerated concern only two, or, at most, very few, generations of the animals in question, and were within the compass of a single man's life-time.

On the other hand, we have data and observations of the most reliable nature, and of an extraordinary compass. These have resulted not from experiments for the determination of a specific question, but from observances of a religious character. They were really in the nature of surgical operations, but for our purpose may be looked upon as experiments, and have the value of contrived experiments. In no other field has such a series of disinterested experiments been available. They were conducted on countless millions of mankind and for thousands of years. The subjects experimented upon were kept isolated from others alike by their own prejudices and the prejudices of their neighbors. Circumcision is the term applied to the experiments in question.

For about 4,000 years circumcision has been practiced on a gigantic scale. Every male child among the Jews was operated upon, not only in Palestine, but wherever representatives of the race had wandered and adhered to their religion; religion itself was involved in the operation and it was regarded as a holy rite; the most scrupulous attention was paid to details. The operation was performed eight days after birth, and consequently there could be no functional activity of the tissues concerned. But after 4,000 years the new-born boys of the race come into the world with the special integument developed as much as in those of other races. Even the princiciple of atrophy through disuse has not become manifest in the case.

Other evidence, it seems to me, is the result of confounding the potentiality of a function with its manifestation. I allude to one set of examples on account of the interest of the cases, and I do so with the deference due to the eminence and abil-

ity of the gentleman who has furnished the evidence. That evidence has been collected under the head of "inheritance of characters due to the exercise of function." The evolution of the American trotting-horse was considered. It was recorded that "by 1810 the taste for trotting as a sport had * * * increased here, and in 1818 it became a recognized sport under specific rules." * * * "At the end of 1824, six years after the first accepted three-minute record, the record had fallen to 2:34." * * * "By 1848 the record was lowered to 2:29½; the next decade lowered the record five seconds." Finally, at the close of 1895, the record had been further lowered to 2:03¾. * * * It is deduced from these premises that "there is nothing whatever in the actual phenomena observed anywhere along the line of this development of speed that would lead us to even suspect that the changes due to exercise of function had *not* been a factor in the evolution." But to me it seems that there is no evidence to show that the speed attained was other than would have resulted from taking the same animals untrained and then speeding the last. The speed is, of course, simply the expression of functional adaption, and the horses were selected merely because, by their manifestation, they showed that they had the co-ordination of structural and psychological characters needed for the manifestation of the function. The manifestation guided the breeder to the selection of the animals. The successful animals were the pick of thousands unknown to fame.

But there is much in the history of the development of animals that seems to lead to the belief that eventually modifications may be due in part to acts of representatives of the phylum to which they belong. It is difficult to believe that some structural features are simply the result of natural selection operating on chance variations. An application of the doctrine of chances to some such cases appears to be adverse to the conception that they represent the influence of natural selection unaided.

A feature characteristic of most cave animals of widely diverse groups and classes is the atrophy of the eyes, and it seems to be most logical to attribute this to disuse of those organs in

remote progenitors, and to assume that the atrophy may have resulted from a failure of nourishment by the nutrient fluid of the organs on account of the loss of functional activity rather than to selection by nature of forms with successively diminishing eyes. The presence of eyes in most cases certainly would scarcely be an element of disadvantage to animals, and it may be allowable to invoke some other agency than chance selection. We may be justified in postulating that the continuous disuse of the organs would in time react on the nutrition of the parts affected, and finally atrophy or disappearauce would result. Like explanation would be applicable to the innumerable cases of atrophy of parts known to the naturalist.

But if cessation of nutrition culminates in final atrophy, increased nutrition of parts may result in hypertrophy and increased nutrition may be the concomitant of increased activity of parts. The exercise of such parts continued for many generations may react on the organization and the progeny at length be affected thereby. Of such cases Cope adduced many examples. The feet of the horse line furnish illustrations. The existing horse has the median toes and hoofs greatly hypertrophied and the lateral ones atrophied, but the remote ancestors had feet of nearly the same general pattern as the rhinoceroses and tapirs. Atrophy of the lateral digits has progressed inversely to hypertrophy of the middle ones. An analogous line of development culminating in feet superficially much like those of the horse was followed by another quite remote family of hoofed mammals, the Prototheriids of South America.

The idea of acceleration and retardation was associated by Cope with the idea that the course of evolution was determined from the beginning of things, and that life, to use his own words, is "*energy directed by sensibility or by a mechanism which has originated under the direction of sensibility.*" He maintained that "consciousness as well as life preceded organism," and he called this conception "the hypothesis of archæsthetism." This idea I refer to especially because it was broached in his vice-presidential address, delivered at the meeting of the American

Association for the Advancement of Science, in Philadelphia, in 1884.[28]

I am, myself, unable to comprehend consciousness except as a product or result of organization, and those who wish to learn more about Cope's views respecting the question must refer to one of his many papers.

Whatever may be thought of Cope's philosophical views, his presentation of them is always interesting, and some of them are illustrated with a wealth of facts that renders his communications valuable as repertories of well digested information. His first special paper, on "The Origin of Genera," published as early as 1868, is especially noteworthy for the mass of morphological data contained in it, and for the apt manner in which they are tabulated.

VIII.

I venture to conclude with some reflections on the rank that may be assigned to Cope in the world of science.

Among those that have cultivated the same branches of science that he did—the study of the recent as well as the extinct Vertebrates—three naturalists have acquired unusual celebrity. Those are Cuvier, Owen and Huxley.

Cuvier excelled all of his time in the extent of his knowledge of the anatomical structure of animals and appreciation of morphological details, and first systematically applied them to and combined them with the remains of extinct Vertebrates, especially the mammals and reptiles. He was the real founder of Vertebrate paleontology.

Owen, a disciple of Cuvier, followed in his footsteps, and, with not unequal skill in reconstruction and with command of ampler materials, built largely on the structure that Cuvier had begun.

Huxley covered as wide a field as Cuvier and Owen, and likewise combined knowledge of the details of structure of the recent forms with acquaintance with the ancient ones. His actual investigations were, however, less in amount than those of either his predecessors. He excelled in logical and forcible presentation of facts.

[28] **Origin of Fittest, p. 425.**

Cope covered a field as extensive as any of the three. His knowledge of structural details of all the classes of Vertebrates was probably more symmetrical than that of any of those with whom he is compared; his command of material was greater than that of any of the others; his industry was equal to Owen's; in the clearness of his conceptions he was equalled by Huxley alone; in the skill with which he weighed discovered facts, in the aptness of his presentation of those facts, and in the lucid methods by which the labor of the student was saved and the conception of the numerous propositions facilitated, he was unequalled. His logical ability may have been less than than that of Huxley and possibly of Cuvier. He has been much blamed on account of the constant changes of his views and because he was inconsistent. Unquestionably he did change his views very often. Doubtless some of those changes were necessitated by too great haste in formulation and too great rashness in publication. The freedom to change which he exercised, and which was exercised too little by at least one of his predecessors, was an offset to his rashness. He exercised a proper scientific spirit in refusing to be always consistent at the expense of truth.

His reputation at present is much inferior, at least among the people at large, to those of the men with whom he has been compared. Immediate reputation depends on various circumstances, some of which are quite adventitious, and it is often long before men find their true levels. It is scarcely premature to prophesy that Cope's reputation will grow and that in the future history of science his place will be at least as large as that of any of his predecessors.

NEW OBSERVATIONS ON THE ORIGIN OF THE GALÁPAGOS ISLANDS, WITH REMARKS ON THE GEOLOGICAL AGE OF THE PACIFIC OCEAN.

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No. II.

THE GEOGRAPHICAL DISTRIBUTION OF DIFFERENT ANIMALS IN THE PACIFIC AND INDO-PACIFIC OCEANS.

We will now examine the distribution of a number of animals in the Pacific, in order to find out how this distribution agrees with the theories of the origin of this Ocean.

Ortmann[28] has shown that there is a uniform Indo-pacific Litoral Region.

Distribution of Pocillopora Lam.

Pocillopora,[29] a coral of the Madreporaria, is found only in the Indo-pacific region. It is represented by an extraordinary large number of forms reaching north to the Loo Choo and Sandwich Islands, and it is also common on the west coast of America. It is totally absent, however, from the Caribbean or West Indian Sea and the eastern American coral region. A few fossil forms are known since the miocene, *Pocillopora madreporacea* (Lam.), from Dax and Turin.

It is of the highest interest, that the members of the Decapod Family Trapeziidæ[30] shows exactly the same distribution as Pocillopora. I am greatly obliged to my friend Dr. Ortmann for calling my attention to this fact. In his recent paper on

[28] Ortmann, Arnold E. Grundzüge der marinen Thiergeographie. Jena, 1896.

[29] Ortmann, A. Studien über Systematik und geographische Verbreitung der Steinkorallen. Zoolog. Jahrb. Abtheil. f. System., II, Band, p. 143-188, Tafel VI, 1888.

[30] Ortmann, Arnold E. Die geographische Verbreitung der Decapoden Familie Trapeziidæ. Zool. Jahrb., Abth. f. System., X, Band, p. 201-216, 1897.

the geographical distribution of the Trapeziidæ, he makes the following remarks: "It is a very important fact, that all the members of this family are limited to an exceedingly peculiar habitat, the coral reefs; only a single species, *Quadrella coronata,* is said to occur between pearl-shells in the Panama Bay; but this case is certainly an exceptional one. All the other species are known from coral reefs. The Trapeziidæ are especially inhabitants of *living* corals, and live between the network of their fine branches. This mode of life characterizes them as typical littoral forms, which are found from the tidal zone to the same approximate depth to which the corals reach; the greatest depth mentioned is 22 fathoms in *Trapezia cymodoce* (Herbst)."

I shall now give the geographical distribution of the Trapeziidæ from Ortmann.

Geographical Distribution of the Decapod Family Trapeziidæ.

Trapezia Latreille 1825.

1. *Trapezia cymodoce* (Herbst) 1801.

Distribution: Probably everywhere in the Indo-Pacific littoral region, where coral reefs are found, from tide mark to 22 fathoms; Red Sea; East Africa: Dar-es Salaam; Glorioso, Amirante Islands, Seychelles; Maledives; Southern India; Ceylon; Mergui Islands; Singapore; Java; Borneo; Phiiippines; Loo Choo Islands; Moluccas; New Guinea; Queens land; New Caledonia; Fiji Islands; Tongatabu; Tahiti; Marquesas Islands.

2a. *Trapezia ferruginea dentata* (Macleay), 1838.

Distribution: Sulu Islands; Pelew Islands; Fiji Islands; Tongatabu; Samoa Islands; Tahiti; Paumatu Islands.

2b. *Trapezia ferruginea* Latreille, 1825.

Distribution: Red Sea; Zanzibar; Mauritius; Seychelles; Ceylon; New Caledonia; Samoa; Tahiti; Marquesas; Sandwich Islands; Panama Bay: Pearl Islands; Acapulco.

2c. *Trapezia ferruginea guttata* Rüppel, 1830.

Distribution: Red Sea; Seychelles; Loo Choo; Fiji; Samoa Islands; Tahiti.

2d. *Trapezia ferruginea maculata* (Macleay), 1838.

Distribution: Red Sea; Zanzibar; Glorioso Group and Amirantes; Rodriguez; Ceylon; New Caledonia; Samoa; Tahiti; Sandwich Islands; west coast of Mexico: Socorro Islands.

2e. *Trapezia ferruginea areolata* Dana, 1852.

Distribution: Ceylon; Nicobares; Java; Celebes; Amboina; Sulu Sea; Loo Choo Islands; New Caledonia; Fiji; Samoa Islands; Tahiti.

3a. *Trapezia rufopunctata* (Herbst), 1799.

Distribution: East Africa: Dar-es-Salaam; Ceylon; Tuticorin; Java; Philippines: Samboangan; Amboina; Samoa; Tahiti; Marquesas; Sandwich Islands.

3b. *Trapezia rufopunctata flavopunctata* Eydoux et Souleyet, 1841.

Distribution: Mauritius; New Caledonia; Tahiti; Sandwich Islands.

4a. *Trapezia digitalis* Latreille, 1825.

Distribution: Red Sea; Mauritius; Marquesas Islands; west coast of Central America; Panama Bay; Pearl Islands: Veragua; Cape St. Lucas.

4b. *Trapezia digitalis speciosa* Dana, 1852.

Distribution: Mauritius; Paumotu Islands.

4c. *Trapezia digitalis bella* Dana, 1852.

Distribution: Paumotu Islands.

Tetralia Dana, 1852.

1. *Tetralia glaberrima* (Herbst), 1790.

Distribution: Red Sea; Zanzibar; Dar-es-Salaam; Ibo; Natal; Madagascar; Nossi Bé; Rodriguez; Amirantes; Seychelles; Southern India; Java; Hong Kong; Loo Choo Islands; Amboina; New Caledonia; Fiji; Tongatabu; Tahiti; Paumotu; Marquesas Islands.

Quadrella Dana, 1852.

1. *Quadrella coronata* Dana, 1852.

Distribution: Indian Ocean; Providence Island; Sulu Sea; Panama Bay: Pearl Islands, between pearl shells.

Ortmann makes the following remarks: "The distribution of the Trapeziidæ is very simple but characteristic, and agrees very well with the limitations of the modern geographical regions of animals. Wherever in the whole Indo-Pacific area coral reefs are found, there are also *Trapeziidæ.* Most of the species and subspecies extend over the whole Indo-Pacific region, from the Red Sea and East Africa to the Loo Choo and Sandwich Islands, to Queensland in Australia and to the Paumotu Islands [and even the west coast of Central America]. Some forms, according to the present data, seem to be a little more limited, for instance, *Trapezia ferruginea dentata* has not yet been recorded from the Indian, but is found from the Sulu Sea eastwards; *Trapezia ferruginea areolata* is known eastward from Ceylon; *Trapezia digitalis bella* only from the Paumatu Archipelago. It is quite possible, however, that these forms will be discovered later in those places where they at present have not yet been found. Some species (*Trapezia digitata speciosa* and *Quadrella coronata*) have been found only in few isolated places, but these places are so far distant from each other, that we can assume with certainty their general distribution, even if they might be rare forms.

At the west coast of America it is not possible to distinguish any well characterized peculiar species; the four species mentioned from this region are also found in the Indo-Pacific region. Therefore, we must conclude, that the west American Region received these species from the Indo-Pacific. How these forms were able to pass the barrier of the open Pacific Ocean, can only be guessed. Migration along the North Pacific shore line is impossible, the Trapeziidæ being exclusively tropical forms; the conditions of former geological times can not be considered, since this family, as will be seen immediately, is of very recent age. Only one supposition remains, that the *Trapeziidæ* possess means of migration in free swimming planctonic larvæ, which enable them to reach inside the tropics, the western coast of America from the Pacific Islands. This, however, remains a simple supposition; we know nothing whatever about the propagation and development of the *Trapeziidæ* and about their eventual larvæ."

Ortmann believes that this is also the reason why so few forms of the Trapeziidæ are found in the West American region. After this he makes some very important remarks about the geological age of the Trapeziidæ.

"The distribution of the Trapeziidæ also demonstrates an important fact, which is of significance for the consideration of the geological age of this family. While represented on the western side of America, it is *totally* absent from the eastern side, especially in the West Indian Seas, so rich in corals. This fact is to be considered still the more, since the West and East American littoral regions show considerable relationship. This resemblance, however, must be explained by the former history of the American seas; that is, the well known and generally accepted union between the Caribbean Sea and the Pacific Ocean, which existed in the middle of tertiary time. The fact that the *Trapeziidæ* were unable to migrate into the Caribbean Sea, indicates that the land connection between North and South America was already finished during the time of their origin or their immigration into the West American littoral region, preventing their further eastern advance. From this reason we have to consider the Trapeziidæ as a relatively young family, which can not be older than the formation of this land barrier; that is, not older than Middle Tertiary (Miocene), but possibly still younger.

"Especially the Trapeziidæ indirectly prove that the relations between the tropical West Indian and tropical Indo-Pacific faunas can only be explained by a connection in *former* times, which does no longer exist, for they demonstrate that a group of animals, arising in the Indo-Pacific region after its isolation in its present form, and which seems to have the power to pass over extensive areas of the sea, was unable to reach the eastern American region. The Trapeziidæ could pass the barrier of the open Pacific and thus reach the western coast of America, but they could not enter the Atlantic Ocean; on one side they were prevented by the Isthmus of Central America, on the other side they could not pass the southern point of Africa, which is doubtless caused by the prevailing conditions of temperature in that region."

The general distribution of Pocillopora and the Trapeziidæ in the Indo-Pacific region, can only be explained by a former land connection of this region. Let us suppose for one moment that the Pacific Islands had been elevated gradually by volcanic activity, how was it possible that Pocillopora and at the same time the Trapeziidæ reached all these islands? There were no corals or Trapeziidæ near these islands which were elevated from the ocean. If we consider the Pacific Islands as the remains of a former Pacific continent, we have no difficulty whatever in explaining the general distribution of Pocillophora and the Trapeziidæ. Both are of recent origin (miocene) and demonstrate that the Pacific continent must have still existed just before this time. I have shown that the Galápagos Islands were separated from Central America during the miocene, and the geology of the Fiji Islands shows that the first sedimentary strata are also miocene.

We may now examine the distribution of a family of Decapods, the *Atyidæ*, which is confined to the fresh-water.[31]

Geographical Distribution of the Decapod Family Atyidæ Kingsley.

ATYIDÆ.

Hiphocaris v. Martens, 1872.

1. *Hiphocaris elongata* (Guèrin), 1857.

Distribution: Fresh-waters of the Antilles; Cuba; Hayti; Dominica; San Domingo.

2. *Hiphocaris compressa* (de Haan), 1849.

Distribution: Fresh-water of Australasia; Japan: Yokohama, Tokio; Island of Adenare, near Flores; Queensland: Burnett.

Troglocaris Dormitzer, 1853.

1. *Troglocaris schmidti* Dormitzer, 1853.

Distribution: In the waters of the caves of Carniola; caves of Kumpole and Gurk (Dormitzer).

[31] Ortmann, Arnold E. A Study of the Systematic and Geographical Distribution of the Decapod Family Atyidæ Kingsley. Proc. Acad. Nat. Sci. Phila., 1894, p. 397--416.

Atyaëphyra Brito-Capello, 1866.

1. *Atyaëphira desmarestii* (Millet), 1832.
Distribution: Fresh-water of southern Europe.—Portugal: Coimbra; Southern and Western France; Corsica; Sicily; Dalmatia.

Caridina Milne-Edwards, 1837.

1. *Caridina typus* Milne-Edwards, 1837.
Distribution: Fresh-water of the islands of the Indian Ocean and of Indo-Malayasia; Mauritius; Rodriguez; Seychelles; Siam; Flores; Timor; Saleyer; Celebes; Amboina; Loo Choo.
2. *Caridina americana* Guèrin, 1857.
Distribution: Cuba; Dominica.
3. *Cardinia brevicarpalis* de Man, 1892.
Distribution: Celebes; Amboina.
4. *Cardinia weberi* de Man, 1892.
Distribution: Sumatra; Java; Saleyer; Celebes; Flores.
5. *Cardinia japonica* de Man, 1892.
Distribution: Japan: Kagar, Hayagana.
6. *Cardinia pareparensis* de Man, 1892.
Distribution: Celebes.
7. *Cardinia timarensis* de Man, 1893.
Distribution: Timor.
8. *Cardinia parvirostris* de Man, 1892.
Distribution: Flores.
9. *Cardinia richtersi* Thallwitz, 1891.
Distribution: Mauritius.
10. *Caridina laevis* Heller, 1862.
Distribution: Java.
11. *Caridina multidentata* Stimpson, 1860.
Distribution: Bonin Island; Celebes.
12. *Caridina africana* Kingsley, 1882.
Distribution: S. Africa: Zulu Land.
13. *Caridina fonarum* Heller, 1867.
Distribution: Persia: Schiraz.
14. *Caridina serratirostris* de Man, 1892.
Distribution: Flores; Saleyer; Celebes.

15. *Caridina wycki* (Hickson), 1888.
Distribution: From East Africa to Eastern Australia.—East Africa; Dar-es-Salaam; Ceylon; Celebes; Saleyer; Flores; Timor; Queensland: Burnett.
16. *Caridina nilotica* (Roux), 1833.
Distribution: Northern Africa; Nile; Algiers; River Macta near Oran.
17. *Caridina grandirostris* Stimpson, 1860.
Distribution: Loo Choo Islands.
18. *Caridina gracilirostris* de Man, 1892.
Distribution: Sumatra; Celebes; Saleyer; Flores.
19. *Caridina singhalensis* Ortmann, 1894.
Distribution: Ceylon.
20. *Caridina brevirostris* Stimpson, 1860.
Distribution: Loo Choo.
21. *Caridina pasadenæ* Kingsley, 1896.*
Distribution: Southern California.

Atyoida Randall, 1839.

1. *Atyoida potimirim* F. Müller, 1881.
Distribution: Brazil: Itajahy.
2. *Atyoida bisulcata* Randall, 1839.
Distribution: Hawaiian Islands; Oahn; Tahiti.

Atya Leach, 1817.

1. *Atya moluccensis* de Haan, 1849.
Distribution: Fresh-water of the Indian Archipelago; Sumatra; Java; Batjan; Bali; Celebes; Saleyer; Ceram; Timor; Flores; Amboina; Philippine Islands: Samar.
2. *Atya spinipes* Newport, 1847.
Distribution: *This species represents A. molluccensis in the fresh-water of the Pacific Islands;* Philippine Islands; Caroline, Fiji, Samoa Islands.
3. *Atya brevirostris* de Man, 1892.
Distribution: Flores; Timor; Amboina.
?4. *Atya margaritacea* A. Milne-Edwards, 1864.

* Added by Prof. Kingsley.

Distribution: New Caledonia.

?5. *Atya robusta* A. Milne-Edwards, 1864.

Distribution: New Caledonia.

6. *Atya scabra* Leach, 1815.

Distribution: Fresh-water of Central America and the West Indies and the Cape Verde Islands.—Mexico; Nicaragua; Cuba; Hayti; Jamaica; Dominica; Martinique; Tobago.—Cape Verde Islands; San Nicolao; San Jagoo.

7. *Atya gabonensis* Giebel, 1875.

Distribution: Gaboon; Orinoco.

8. *Atya crassa* Smith, 1871.

Distribution: Nicaragua; Mexico: Presidio.

I have to thank my friend, Dr. Ortmann, for calling my attention to this paper. I make the following quotations from it: "*Some species of Atyidæ were formerly considered to be marine animals; there is now no doubt that this family contains only fresh-water forms. This family is probably one of the most primitive groups of Decapods living in fresh-water, having immigrated at an early geological period.*" (Italics are mine).

"The geographical range of the Atyidæ embraces the whole of the circum-tropical parts of the world, members of the family being recorded from all the localities explored within these limits. Only in two localities does the range exceed the true tropics; in Japan, where it extends as far north as Tokio, and in the Mediterranean province, where it extends northward to Southern France and Southern Austria." The description by Kingsley of *Caradina pasadenæ* from Pasadena, California, since Ortmann wrote these words hardly makes necessary a modification in them, for Southern California is sub-tropical in its temperature. (Kingsley).

"The most primitive genus, Hiphocaris, shows a distribution the peculiarity of which can only be understood by supposing that the range of this genus was formerly a more extended one, but that in most parts of the world the representatives were exterminated. Only three species survived, one of which lives now in the fresh-waters of the West Indies, the other in Indo-Malaysia, from Japan to Australia, and the third in New Zealand. The closely allied genus Troglocaris, the only spe-

cies of which might be regarded as a fourth form of Xiphocaris, lives in the subterranean waters of Carinola, a perfectly isolated locality in no way connected with the others named. The third primitive genus, Atyaëphyra, is found near the locality of Troglocaris on the northern borders of the Mediterranean Sea. The scattered localities at which are found the species of these three genera forming the subfamily Xiphocarinæ are no doubt the remains of a more universal distribution in former times; the species now living show the character of true survivals."

"In the subfamily Atyinæ, the genus Atyoida shows a survival character similar to that of the Xiphocarinæ, being recorded from the Sandwich Islands, Tahiti and Southern Brazil."

"The genus Caridina appears to be nearly a circumtropical one. Its range is divided into two very unequal parts; the one comprising the West Indies [and California] and containing only one [two] species, the other comprising a continuous area of the Old World and containing at least nineteen other species. This area extends from South Africa along the east coast to the southern borders of the Mediterranean Sea and to Persia, crossing the islands of the Indian Ocean and Indo-Malaysia to Japan and Australia. It is very probable that further investigations will prove that the range of *Caridina* is a somewhat different one, since fresh-water crustacea of smaller size are mostly neglected by collectors, and the fauna of the fresh-waters of most tropical countries are very little known."

"The distribution of the most extreme genus of the family Atya is somewhat similar to that of Caridina. It is found, like the latter, in the West Indies and Indo-Malaysia, but there are some modifications. One species is known from West Africa, which is identical with another described from the Orinoco, and there is recorded one species from the Cape Verde Islands, identical with the common West Indian form." "The other range of the genus Atya extends over the islands of the Pacific from Sumatra to the Samoan Islands" [and western Central America].

"The conditions of geographical distribution of the Atyidæ are as follows:—

1. The Atyidæ can not endure cooler climates (*climatic barriers*).

2. They are true fresh-water animals (oceans and tracts of land without water form *topographic barriers*).

3. Being animals of an ancient type, they are probably restricted by the occurrence of other fresh-water animals (*bronomic barriers*).

4. The faculties of distribution are very limited.

The Atyidæ are, therefore, confined to the fresh-waters of the tropics and subtropics; the distribution of the genera and species, especially of the more primitive ones, shows a remarkable character of survival. Only Caridina and Atya are of a more recent character, extending over continuous areas within the tropics. Because of the antiquity of the family it has no relations among the recent forms of the littoral regions of the tropical seas."

The following conclusions can be drawn from the distribution of the Atyidæ. The distribution of Cardinia shows that there must have existed a land connection between Africa, the Mascaren Islands, the Seychelles, Persia, Ceylon, the Sunda Islands, the Mollucas, Siam, the Loo Choo Islands, Japan and the Bonin Islands, and between the Mollucas and Australia.

The distribution of Atya shows that this land area extended over the Philippine, Caroline, Fiji and Samoa Islands, and the presence of *Atyoida bisulcata* on the Society and Sandwich Islands, proves that this land extended also to these islands and probably also to the west coast of America (*Atya scabra* Mexico, *Nicaragua* Baur). The presence of *Cardinia paredena* Kingsley, in Lower California is another proof of this connection. The presence of *Atya scabra* on the Cape Verde Islands, and of *Atya gabonensis* in Gaboon and the Orinoco, can only be explained by a former connection of Africa and America (Ortmann).

Geographical Distribution of the Formicidæ of the Pacific Ocean.

The Formicidæ are a very old group. Their first remains have been found in the lowest Jurassic: *Palæomyrmex prodromus* Heer,[32] Lower Lias of Schamblen, Canton Aargau, Swit-

[32] Heer O. Die Urwelt der Schweiz. Zürich., 1865, p. 91.

zerland. In the lower Purbeck of Durdlestone Bay, England occur *Formicium brodiei* Westwood, and *Myrmecium heeri* Westwood,[33] and several forms have been described from the Kimmeridgean of Solnhofen, Bavaria. Very rich are the Amber-Beds of the lower Oligocene of the Samland,[34] north of Königsberg, and the well-known Florissant Beds of Colorado. Scudder remarks, that about one-fourth of all the Insects from Florissant are ants, more than 4000 specimens, representing 34 genera and 170 fossil species. Among Miocene localities may be named Oeningen in Baden, and Radoboj in Croatia.[35]

I now give a list of the distribution of the *Formicidæ* of the Pacific Ocean, from Ihering,[36] with some additions from Emery[37] and Smith.[38] Many of the additional localities have been kindly supplied by Mr. Theo. Pergande of the Department of Agriculture, Washington.

Family Formicidæ,

Subfamily: *Ponerinæ* Mayr.

1. *Ponera insulana* Mayr. Samoa.
2. *Ponera* sp. aff. *contracta* Latr. Sandwich Islands.
3. *Ponera castanea* Mayr. New Zealand.

1. *Ectatomma metallicum* Smith. Samoa, Australia.
2. *Ectatomma mayri* Emery. New Zealand (or Australia?).
3. *Ectatomma brownii* Forel. New Zealand.

1. *Amblypone cephalotes* Smith. New Zealand.
2. *Amblypone saundersii* Forel. New Zealand.

1. *Leptogenys insularis* Smith. Sandwich Islands.

[33] Westwood J. O. Contributions to fossil entomology. Quart. Journ. Geol. Soc. X, pp. 388, 393, 390, 396, 1854.

[34] Mayr. Gustav Leopold. Die Ameisen des Baltischen Bernsteins. Mit 106, Figuren auf. 5 Tafeln. (Beiträge z. Naturkunde Preussens I), pp. 4, 102, (10), tab. 5. 4° Königsberg, 1868.

[35] Mayr. Gustav Leopold. Vorläufige Studien über die Radoboj-Formiciden Jahrbuch d. k. k. geolog. Reichs-Anstalt, Bd. XVII, p. 47–62, Taf. I, 1867.

[36] Ihering, H. von. Die Ameisen von Rio Grande Sul. Berliner Entom. Zeitschr. Bd. XXXIX, pp. 434–436, 1894.

[37] Emery, C. Notice sur quelques Fourmis des îles Galapagos. Ann. Soc. Entom. France, vol. LXII, p. 89–92, 1893.

[38] Smith, Fred. [Hymenoptera Galapagos]. Proc. Zool. Soc., p. 83, 1877.

1. *Odontomachus hæmatodes* Linn. Tonga, Samoa, Fiji, Borneo, Java, Celebes, Ceylon, Amboina, Australia, Guiana, Columbia, Mexico, Texas, Florida.
2. *Odontomachus angulatus* Mayr. Fiji Islands.
3. *Odontomachus bavri* Emery. Galápagos Islands.
1. *Anochetus græffei* Mayr. Samoa.

Subfamily: *Myrmicinæ* Mayr.

1. *Strumigenis antarctica* Forel. New Zealand.
2. *Strumigenis godeffroyi* Mayr. Samoa.
1. *Orectognathus antennatus* Smith. New Zealand.
2. *Orectagnathus perplexus* Smith. New Zealand.
1. *Monomorium pharaonis* Linn. Samoa, Australia, Chile, La Plata, India, Singapore, Batavia, Manilla, Ceylon, Brazil, Eastern and Southern States, N. A., Egypt, Cape Colony, Italy, France, South Germany, England.
2. *Monomorium speculare* Mayr. Samoa, Tonga, Borneo, India.
3. *Monomorium antarctium* White. New Zealand.
4. *Monomorium suteri* Forel. New Zealand.
5. *Monomorium smithii* Forel. New Zealand.
1. *Cardiocondyla nuda* Mayr. Fiji, Samoa, Tonga, India.
1. *Tetramorium pacificum* Mayr. Tonga, Samoa.
2. *Tetramorium simillimum* Smith. Samoa, Java.
3. *Tetramorium tonganum* Mayr. Tonga.
4. *Tetramorium guineense* Fabr. Fiji, Tonga, Sandwich Is., Galápagos Island, Manilla, Sidney, Madagascar, Cuba, S. Domingo, California.
1. *Vollenhovia samœnsis* Mayr. Samoa.
1. *Huberia striata* Smith. New Zealand.
1. *Solenopsis geminata* Fabr. New Zealand, Tahiti, Sandwich Islands, Chile, La Plata, Brazil.
1. *Pheidole megacephala* Fabr. Sandwich Islands, Ceylon, Madeira, Bahamas, Brazil.
2. *Pheidole sexspinosa* Mayr. Samoa, Ellice Islands.
3. *Pheidole umbonata* Mayr. Samoa, Tonga Islands.
4. *Pheidole oceanica* Mayr. Samoa, Tonga, Ellice Islands.

Subfamily *Dolichoderinæ.*

1. *Tapinoma melanocephala* Fabr. Samoa, Tonga, Galápagos Islands, Singapore, Cayenne, West Indies, Madagascar.
1. *Plagiolepis gracilipes* Smith. India, Singapore, Celebes, China, Australia, Samoa, Tonga, Ellice Islands, Chili.
1. *Technomyrmex albipes* Smith. Ceylon, Sunda Islands, Samoa, Tonga, India, Hong Kong, Papua.
1. *Tridomyrmex gracilis* Lowne. Samoa, Australia.
2. *Tridomyrmex rufoniger* Lowne. Samoa, Australia.

Subfamily *Camponotinæ* Forel.

1. *Camponotus novæ-hollandiæ* Mayr. Australia, Samoa, Tonga, Ellice Islands.
2. *Camponotus cristatus* Mayr. Fiji Islands.
3. *Camponotus laminatus* Mayr. Fiji Islands.
4. *Camponotus schmeltzi* Mayr. Fiji Islands.
5. *Camponotus sexguttatus* Fabr. Sandwich Islands, South America, Island of Santa Cruz, West Indies, Canary Islands.
6. *Camponotus pallens* Guill. Tonga Islands.
7. *Camponotus pallidus* Smith. Fiji, Tonga, Samoa Islands.
8. *Camponotus subtilis* Smith. Fiji Islands.
9. *Camponotus senex* Smith. Galápagos Islands, Brazil, Central America, Mexico.
10. *Camponotus planus* Smith. Galápagos Islands.
11. *Camponotus macilentus* Smith. Galápagos Islands.
12. *Camponotus peregrinus* Emery. Galápagos Islands.
1. *Colobopsis dentata* Mayr. Fiji Islands.
2. *Colobopsis carinata* Mayr. Fiji Islands.
3. *Colobopsis oceanica* Mayr. Fiji Islands.
4. *Colobopsis nigrifrons* Mayr. Tonga Islands.
5. *Colobopsis conica* Mayr. Tonga Islands.
6. *Colobopsis rufifrous* Smith. Tonga, Fiji, Molluccan Islands.
1. *Prenolepis vividula* Nyl. Tonga, Samoa, Ellice Islands, Australia, Madagascar, Texas.
2. *Prenolepis longicornis* Latr. Samoa, Chile, Senegal, N. America, Batavia, Ceylon, Mexico, Cuba, Madeira.
3. *Prenolepis clandestina* Mayr. Sandwich Islands, Java.

I have very little doubt, that on many groups of Islands, on which, so far as I know, no Formicidæ have been recorded, they will be found, when these Archipelagos will be thoroughly examined; for instance the Pelew and Marianne Islands, the Carolines, the New Hebrides, the Cook, Paumatou, Marquesas and Juan Fernandez.

It is quite evident, that this distribution of the *Formicidæ* cannot be explained by accidental introduction. Also here we are forced to accept a former Pacific Continent.

The *Fiji Islands* have four endemic species of *Camponotus; three* of *Colobopsis;* one of *Odontomachus;* the *Tonga Islands* one endemic species of *Camponotus;* two of *Colobopsis,* one of *Tetramorium;* the *Samoa Islands,* one endemic species of *Anochetus,* one of *Strumigenys* and one of *Vollenhovia;* the *Sandwich Islands* one endemic species of *Ponera,* and one of *Leptogenys;* the *Galapagos Islands* three endemic species of *Camponotus,* and one of *Odontomachus.*

The Fiji, Tonga and Samoa Islands have in common one species of *Camponotus* and one of *Cardiocondyla* (also found in India); the Samoa, Tonga, Ellice Islands and Australia one *Camponotus;* the Fiji, Tonga, Moluccan Islands, one *Colobopsis;* the Sandwich Islands and Java, one *Prenolepis;* Samoa and Australia, two *Tridomyrmex,* one *Ectatomma;* Samoa and Java, one *Tetramorium;* Samoa and Ellice Islands, one *Pheidole;* Samoa and Tonga Islands, one *Pheidole* and one *Tetramorium;* Samoa, Tonga, Sunda Islands, Ceylon, Indi , Hong Kong, Papua, one *Technomyrmex;* Tonga, Samoa, Borneo, India, one *Monomorium;* Samoa, Tonga, Ellice Islands, one *Pheidole;* India, Singapore, Celebes, China, Australia, Samoa, Tonga, Ellice Islands, Chile, one *Plagiolepis;* one Tahiti, Sandwich Islands, New Zealand, Chile, La Plata, Brazil, one *Solenopsis.*

Distribution of Lacertilia.

We shall now examine the distribution of some genera of Lizards; the data are from Boulenger.[39]

[39] Boulenger, G. A. Cat. Lizards Brit. Mus. (2nd edit.), vol. I, pp. 147–156, 162–168. London, 1885.

Family *Geckonidæ.*

Gehyra Gray.

1. *Gehyra mutilata* Wiegm. Mascarene Islands: Mauritius and Rodriguez; Seychelles; Ceylon; Birma, Pegu; Malay Peninsula; Indian Archipelago; Philippines: Negros; Celebes; Timor Laut; New Guinea.—Western Mexico: San Blas and Presidio.

2. *Gehyra oceanica* Lesson. Moluccas; New Guinea; Admiralty Islands: Wild Island; Solomon Islands: Faro I.; Shortland Islands; Lord Howe's Island; Fiji Islands; Tonga Islands: Tongatabu; Samoa Islands; Savage Island; Rarotonga Island.

3. *Gehyra vorax* Girard. Loyalty Islands; New Hebrides: Erromango; Fiji Islands; Norfolk Island.

4. *Gehyra brevipalmata* Peters. Pelew Islands.

5. *Gehyra insulensis* Girard. Sandwich Islands.

6. *Gehyra baliola* A. Dum. New Guinea.

7. *Gehyra variegata* Dum & Bibr. Islands of Torres Str.; Murray Island; Sunday Island; Australia: Champion Bay, Houtman's Abrolhos, Peak Downs.

8. *Gehyra australis* Gray. Australia: Swan River, Port Essington, Port Darwin.

Perochirus Boulenger.

1. *Perochirus ateles* A. Dum. Philippines: Mindanaœ.

2. *Perochirus guentheri* Bouleng. New Hebrides: Erromango.

3. *Perochirus depressus* Fischer. Carolines: Ruk Island.

4. *Perochirus articulatus* Fischer. Carolines: Ponape.

5. *Perochirus scutellatus* Fischer. Greenwich Island, south of Carolines.

Lepidodactylus Fitzinger.

1. *Lepidodactylus aurantiacus* Beddome. Southern India.

2. *Lepidodactylus ceylonensis* Boulenger. Ceylon.

3. *Lepidodactylus lugubris* Dum. & Bibr. Malay Peninsula; Celebes; Amboyna; Murray Island; Pelew Islands; New Hebrides, Fiji, Society Islands: Tahiti; Island of Vati, South Pacific.

4. *Lepidodactylus labialis* Peters. Philippines: Mindanao.
5. *Lepidodactylus pulcher* Bouleng. Admiralty Islands.
6. *Lepidodactylus guppyi* Bouleng. Solomon Islands: Faro I.
7. *Lepidodactylus crepuscularis* Bavay. New Caledonia.
8. *Lepidodactylus cyclurus* Günther. New Caledonia.
9. *Lepidodactylus sauvagii* Bouleng. New Caledonia.

There can be little doubt that the Geckonidæ are a very old family of the Lacertilia, which go back at least to the lower Cretaceous, if not to the upper Jurassic. The distribution of the genera enumerated is very instructive.

Gehyra mutilata Wiegm. extends from the Mascarene Islands to the Seychelles, Ceylon, to the Malay Peninsula, Indian Archipelago, Philippines, Moluccas and New Guinea; it also occurs in western Mexico. This distribution again shows that there has been a land area reaching from the Mascaranes to New Guinea. The next species *Gehyra oceanica* Lesson reaches from the Moluccas eastward to the Cook Islands (Rarotonga), being found on the Admirality, Solomon, Fiji, Tonga and Samoa Islands, Savage Island and Lord Howe's Island. *Gehyra vorax* Girard extends this area to the New Hebrides, the Loyalty Islands and Norfolk Island; *Gehyra brevipalmata* to the Pelew group and *Gehyra insularis* to the Sandwich Islands. This distribution can only be explained by a former Indo-Pacific Continent extending from Malaysia to the west coast of America.

The distribution of the species of *Perochirus* Boulenger and *Lepidodactylus* Fitzinger give new proof for the former existence of this continent.

Family *Scincidæ.*

The family Scincidæ contains several genera, showing a very interesting geographical distribution.[39] These genera are Lipinia Gray, Emoa Gray and Ablepharus (*A. boutonii* Desjard).

Lipinia Gray.

1. *Lipinia semperi* Peters. Philippine Islands: Mindanao.
2. *Lipinia pulchella* Steindachu. Philippine Islands.

[39] Boulenger, G. A. Catalogue of Lizards. Brit. Mus. (Sec. Ed.), vol. III, p. 253–256, p. 290–299, p. 346–348. London, 1887.

3. *Lipinia vulcanica* Girard. Philippine Islands: Caldera, Mindanao.
4. *Lipinia virens* Peters. Southeastern New Guinea.
5. *Lipinia anolis* Bouleng. Solomon Islands.
6. *Lipinia noctua* Lesson. New Guinea, Fiji, Tonga, Samoa, Society and Sandwich Islands.

Emoa Gray.

1. *Emoa cyanura* Lesson. Moluccas; Ternate, Mysol, Timor Laut; New Guinea: Admiralty, Solomon Islands, New Hebrides, Fiji, Savage I., Samoa, Rarotonga, Cook's Islands, Tahiti.
2. *Emoa mivarti* Bouleng. Admiralty Islands: Wild Island.
3. *Emoa cyanogaster* Lesson. Moluccas, New Guinea, Murray Island, Duke of York Island, Solomon Islands and New Hebrides.
4. *Emoa samoënsis* A. Dum. New Hebrides, Fiji, Tonga and Samoa Islands.
5. *Emoa callisticta* Peters & Doria. N. W. Guinea: Soron.
6. *Emoa atrocostata* Lesson. Philippines, Celebes, Moluccas, New Guinea, Santa Cruz and Caroline Islands.
7. *Emoa baudinii* Dum. & Bibr. Celebes, Moluccas, New Guinea.
8. *Emoa singaporensis* Steindachn. Singapore.
9. *Emoa nigra* Hombr. & Iacq. Caroline Islands, New Ireland, Solomon, Banks's, Fiji and Samoa Islands.
10. *Emoa adspersa* Steind. Fiji and Samoa Islands; Savage Island.
11. *Emoa parietalis* Peters. Borneo: Sarawak.
12. *Emoa jerdoniana* Stoliczka. Pinang.
13. *Emoa breviceps* Peters. Gaboon, Camaroons.

Ablepharus boutonii Desjard.

1. *boutonii* Desj. Mauritius, Zanzibar, Mozambique, Comoro Islands.

2. *A. boutonii pœcilopleurus* Wiegm. Peru: Pisacoma Islands; Puna Island, Gulf of Guayaquil; Sandwich Islands; Savage Island; Aldabra (Stejneger).[40]

3. *A. boutonii peronii* Cocteau. Java; Timor; Timor Laut; Amboina; Fly River, New Guinea; Murray Island; Islands of Torres Straits; W. Australia; Tasmania, Fiji Islands; Samoa, and Society Islands, New Hebrides, New Caledonia.

4. *A. boutonii rutilus* Peters. Fly River, New Guinea.

5. *A. boutonii metallicus* Boulenger. North Australia.

6. *A. boutonii quinquetæniatus* Günther. West coast of Africa.

7. *A. boutonii cognatus* Böttg. Nossi Bé, Madagascar.

8. *A. boutonii gloriosus* Stejneger. Glorioso Island.[40]

The genus Lipinia is found on the Philippines, New Guinea, Solomon Islands, Fiji, Tonga, Samoa, Society and Sandwich Islands; Emoa in Pinang; on the Moluccas New Guinea, Admiralty, Duke of York Island, New Ireland; Solomon Islands, New Hebrides, Fiji, Tonga, Samoa Islands. Tahiti, Savage Island; Rarotonga and Carolines and one species in W. Africa. *Ablepharus boutonii* Desjard. shows a most interesting distribution. West coast of Africa, Madagascar; Mauritius, Comoro Islands, Glorioso Island, Zanzibar, Mozambique; —Java, Timor, Moluccas, New Guinea, Islands of Torres Straits, North Australia, West Australia, Tasmania; New Caledonia; New Hebrides, Fiji, Samoa, and Society Islands, Savage Island, Sandwich Islands, Puna Island, Gulf of Guayaquil, Pisacoma Islands, Peru.

The distribution of these genera is only to be explained by the former existence of an Indo-Pacific Continent.

The Distribution of the Hydrophidæ.

This family is found in the Pacific; but in the Indian Ocean it only reaches west to the Persian Gulf.[41] It is totally absent

[40] Stejneger, Leonhard. On some collections of Reptiles ana Batrachians from East Africa and the adjacent islands, recently received from Dr. W. L. Abbott and Mr. William Astor Chandler, with descriptions of new species. Proc. U. S. Nat. Mus., vol. XVI, p. 711–741. [No. 970]. Washington, 1893.

[41] Boulenger, G. A. Catalogue of Snakes. Brit. Mus., vol. III, p. 264–309, 1896.

from the Atlantic, and the whole African portion of the Indian Ocean. The Hydrophidæ extend north to Japan, south to Tasmania and New Zealand; east to the west-coast of America from Mexico to Ecuador. Only one species is found on this coast *Hydrus platurus* Linn.; recorded from Salina Cruz, Mexico; Panama; and off the coast of Ecuador.

This family is certainly younger than Miocene, since no members of it, are found in the Westindian Sea. It probably became much differentiated after the formation of the Indopacific Ocean.

The geographical distribution of different genera of Birds on the Pacific Islands.

Let us consider the distribution of different genera of the COLUMBIÆ. Our knowledge of the fossil Columbæ commences with the lower miocene of Allier in France, *Columba calcaria* Miln. Edw. The very peculiar group, represented by the Dididæ (Didus and Pezophaps) from the Mascarene Islands, Mauritius and Bourbon, were exterminated long ago. Living specimens of (*Didus ineptus*) were seen as late as in 1679; of *Pezophaps solitarius* (the Solitaire) in 1761.

The Columbidæ are certainly geologically an old group.

Family TRERONIDÆ.

Subfamily *Ptilinopodinæ.*

Distribution of the genus Ptilinopus Swainson, 1825 (from Salvadori).[42]

1. *Ptilinopus flavicollis* Finsch & Hartl. Timor and Flores.
2. *Ptilinopus xanthogaster* Wagl. Banda, Khoor, Kĕ, Tenimber Islands, Damma Island, and Lettie.
3. *Ptilinopus ewingi* Gould. Northern Australia from Port Essington to Cape York.
4. *Ptilinopus swainsoni* Gould. Eastern Australia from Cape York to New South Wales, the Islands in Torres Strait and S. E. New Guinea.

[42] Salvadori T. Catalogue of the Columbæ or Pigens in the collection of the British Museum, p. 83–112. London, 1893. Catalogue of the Birds in the British Museum, vol. XXI. London, 1893.

5. *Ptilinopus richardsi* Rams. Solomon Islands: Ugi.

6. *Ptilinopus greyi* G. R. Gray. New Caledonia, with Island of Pines; Loyalty Islands: Livu; New Hebrides: Erromango, Aniva, Vatè, Mallicolo; Santa Cruz Islands: Vanicoro.

7. *Ptilinopus perousei* Peale. Fiji, Tonga and Samoa Islands.

8. *Ptilinopus porphyraceus* Temm. Fiji, Tonga Islands and Savage Island.

9. *Ptilinopus fasciatus* Peale. All the Samoan Islands.

10. *Ptilinopus rarotongensis* Hartl. & Finsch. Rarotonga.

11. *Ptilinopus purpuratus* Gmel. Society Islands: Tahiti.

12. *Ptilinopus chrysogaster* G. R. Gray. Society Islands: Huaheine and Raiatea.

13. *Ptilinopus huttoni* Finsch. Austral Group: Island of Rapa.

14. *Ptilinopus coralensis* Peale. Paumotu Group: Island of Carlsoff.

15. *Ptilinopus smithsonianus* Cass. Paumotu Group (some Island).

16. *Ptilinopus dupetit-thouarsi* Néboux. Marquesas: Christina, Nukahiwa.

17. *Ptilinopus mercieri* Des Murs & Prév. Marquesas Islands: Nukahiwa.

18. *Ptilinopus tristrami* Salvad. Marguesas: Hivaoa.

19. *Ptilinopus pelewensis* Hartl. & Finsch. Pelew Islands.

20. *Ptilinopus ponapensis* Finsch. Eastern Carolines: Ruck group.

21. *Ptilinopus hernsheimi* Finsch. Eastern Carolines: Kushai.

22. *Ptilinopus roseicapillus* Less. Ladrone or Marianne Islands.

Chrysœnas Bonaparte, 1854.

This genus is confined to the Fiji Islands. There are three species, each confined to special islands of the group.[42]

1. *Chrysœnas luteovirens* Hombr. & Jacg. Fiji Islands: Balau, Ovalau, Viti Levu.

[42] Salvadori, l. c., p. 155-158.

2. *Chrysœnas victor* Gould. Fiji Islands: Bua, Vanua Levu, Taviuni, Nyami, Lanthala.

3. *Chrysœnas viridis* Layard. Fiji Islands: Kandavu.

Drepanoptila Bonaparte, 1855.

This genus with the single species *Drepanoptila holosericia* Temm. & Knip. is confined to New Caledonia, with the Isle of Pines.[42]

The geographical distribution of these genera is very interesting.

Ptilopinus. The Moluccas have two peculiar species confined to different islands; *Northern Australia* has one, and Eastern Australia with the Island of Torres Strait another peculiar species. Seventeen species are found on the following islands: Solomon I., New Caledonia, Loyalty I., New Hebrides, Santa Cruz Islands, Fiji, Tonga, Samoa, Savage Island; Raratonga, Society Islands; Austral group: Island of Rapa; Paumotu group: Island of Carlsoff; some Island of Paumotu group; Marquesas; Pelew; Eastern Carolines: Ruck group: Kushai; Ladrone Islands. Of these 17 species, 15 are confined to special islands. This fact and the differentiation of the genus *Chrysoenas* restricted to Fiji Islands, into three peculiar species confined to special islands, and *Drepanoptila* with a single species on New Caledonia shows that these many islands were not stocked by immigrants, but that they were formerly connected to form a continent.

The genus *Alectroenas* G. R. Gray, 1840, which belongs to the subfamily Ptilinopodinæ is confined to the Madagascarian region.[42] There are four species:

1. *Alectroenas madagascariensis* Linn. Madagascar with Nossibe Isl.
2. *Alectroenas nitidissima* Scop. Mauritius.
3. *Alectroenas sganzini* Des Murs. Comoro Islands.
4. *Alectroenas pulcherrima* Scop. Seychelles Islands.

This again shows the close relationship between the Madagascarin and the Indo-Pacific region, which, as we have seen before, can only be explained by former land connection.

[42] Salvadori, l. c., p. 158–160.

[42] Salvadori, l. c., p. 160–165.

Subfamily *Carpophaginæ.*[42]

Serresius Bonaparte, 1855.

This genus is restricted with a single species, *S. galeatus* Bonap., to the Marquesus Islands.

Globicera Bonaparte, 1854.

1. *Globicera pacifica* Gmel. From the Samoa Islands on the east to New Guinea; Port Moresby, New Guinea; New Hebrides; Louisiade Archipelago; Fiji Islands; Tonga Islands; Samoa Islands.
2. *Globicera myristicivora* Scop. Western New Guinea and the surrounding western Papuan Islands; Waigiou, Mysol.
3. *Globicera rubricera* G. R. Gray. New Ireland; New Britain; New Hanover and Duke of York Island.
4. *Globicera rufigula* Salvad. Solomon Islands.
5. *Globicera oceanica* Less. Carolines and Pelew Islands.
6. *Globicera auroræ* Peale. Aurora or Maitea Island, Society group.
7. *Globicera wilkesi* Peale. Tahiti, Society group.

The species of these two genera are found from the Papuan Islands and New Guinea to the Marquesas Islands.

Family COLUMBIDÆ.[42]

Subfamily *Columbinæ.*

Janthoenas Reichenbach, 1852.

1. *Janthoenas palumboides* Hume. Andamanes and Nicobars.
2. *Janthoenas janthina* Temm. Japan and Loo Choo Islands.
3. *Janthoenas jouyi* Stejneg. Loo Choo Islands.
4. *Janthoenas versicolor* Stejneg. Bonin Islands.
5. *Janthoenas nitens* Stejneg. Bonin Islands; Parry group: Bailey Islands and Sulphur Islands.
6. *Janthoenas griseogularis* Wald. & Layard. Philippine Islands, from Luzon to Mindanao; and also Sulu Islands and N. Borneo.

[42] Salvadori, l. c., p. 171--181.
[42] Salvadori, l. c., p. 308--319.

7. *Janthoenas metallica* Temm. Timor.

8. *Janthoenas albigularis* Bonap. From the Halmahera and Amboyna groups through the Papuan Islands to the Louisiades.

9. *Janthoenas pallidiceps* Rams. Duke of York Island.

10. *Janthoenas philippana* Rams. Solomon Islands; Ugi.

11. *Janthoenas hypoenochroa* Gould. New Caledonia; Isle of Pines; Loyalty Islands.

12. *Janthoenas leopoldi* Tristr. New Hebrides.

13. *Janthoenas vitiensis* Quoy & Gaim. Fiji Islands.

14. *Janthoenas castaneiceps* Peale. Samoa Islands.

This genus shows a very extensive distribution; Andamans and Nicobars, N. Borneo, Sulu Islands, Philippines, Loo Choo Islands, Japan, Bonin Islands, Timor, Halmahera group, Amboina group, Papuan Islands, Louisiade Archipelago, Duke of York Islands, Solomon, New Hebrides, Loyalty Islands, New Caledonia, Fiji Islands, Samoa Islands.

This distribution is easily explained by the former land connection of the different islands.

Family PERISTERIDÆ.

Subfamily *Geotrigonidæ*.[42]

Genus *Phlegoenas* Reichenbach, 1851.

1. *Phlegoenas luzonica* Scop. Luzon, Philippines.

2. *Phlegoenas crinigera* Reichenb. Mindanoa, Basilan, Philippines.

3. *Phlegoenas platenæ* Hartert. Mindoro, Philippines.

4. *Phlegoenas tristigmata* Temm. N. Celebes, Menado.

5. *Phlegoenas bimaculata* Salvad. S. Celebes, Makassar.

6. *Phlegoenas rufigula* Pucher. & Jacq. New Guinea, with the N. W. Papuan Islands: Waigiou, Salawatti, Mysol and Jobi.

7. *Phlegoenas helviventris* Rosenb. Aru Islands and southern New Guinea.

8. *Phlegoenas beccarii* Salvad. N. W. New Guinea.

9. *Phlegoenas margaritæ* D'Alb. & Salvad. New Guinea, Jobi, Duke of York Island, New Britain.

[42] Salvadori, l. c., p. 583--604.

10. *Phlegoenas johannæ* Sclat. Duke of York Island.
11. *Phlegoenas granti* Salvad. Guadalcanar, Solomon Islands.
12. *Phlegoenas vitiensis* Finsch. Fiji Islands.
13. *Phlegoenas stairi* G. R. Gray. Tonga Islands.
14. *Phlegoenas samoensis* Finsch & Hartl. Samoa Islands.
15. *Phlegoenas canifrons* Hartl & Finsch. Pelew Islands.
16. *Phlegoenas virgo* Reichenow. Pelew Islands.
17. *Phlegoenas pampusan* Quoy et Gaim. Marianne or Ladrone Islands.
18. *Phlegoenas kubaryi* Finsch. Ruk I., Carolines.
19. *Phlegoenas erythroptera* Gmel. Eimeo, Society Islands.
20. *Phlegoenas albicollis* Salvad. Bow Island, Paumotu Islands.
21. *Phlegoenas pectoralis* Peale. Carlsoff, Paumotu Islands.
22. *Phlegoenas yapensis* Hartl. & Finsch. Uap, Mackenzie Islands.

The genus *Phlegoenas* shows a very extensive differentiation of species on the different groups of islands. On the Philippines there are three species, two confined to single islands, and the third to two other islands. Celebes has a peculiar species on the north and one on the south end. One species is found on the N. W. Papuan Islands and New Guinea, another one on the Aru Islands and southern New Guinea, a third one is on New Guinea, Duke of York Island and New Britain. All the other 14 species are restricted to single localities: New Guinea; Duke of York Island; Guadalcanar, Solomon Islands; Fiji Islands; Tonga Islands; Samoa Islands; two to the Pelew Islands; Marianne Islands; Ruk Island, Carolines; Eimeo, Society Islands; Bow Island, Paumotu group; Carlshoff, Paumotu group; Uap, Mackenzie Islands.

This peculiar differentiation of Phlegoenas can only be explained by the former connection of these islands, and not by accidental immigrants. This is another proof for the former existence of a Pacific Continent.

I shall now discuss the geographical distribution of two genera of the Sturnoid Passerine Birds, the Sturniformes.

Section Sturniformes.

Family *Sturnidæ.*

Subfamily *Sturninæ.*[43]

Genus *Aplonis* Gould, 1836.

1. *Aplonis cantor* Müll. Mysol, Salawatti, Batanta, New Guinea, Louisiade Islands, Admirality groups of islands, New Britain, Duke of York Island, Solomon Islands.
2. *Aplonis feadensis* Ramsay. Fead Island.
3. *Aplonis crassa* Scl. Tenimber Islands, Larat, Timor Laut.
4. *Aplonis rufipennis* Layard. New Hebrides.
5. *Aplonis atronitens* Gray. Loyalty Islands.
6. *Aplonis striata* Gmel. New Caledonia, Isle of Pines.
7. *Aplonis fuscus* Gould. Norfolk Island and Lord Howe's Island.
8. *Aplonis vitiensis* Layard. Fiji Islands, Rotumah Island, (north of Fiji Islands).
9. *Aplonis tabuensis* Gmel. Tonga Islands.
10. *Aplonis fortunæ* Layard. Fortuna Island (between Fiji and Samoa Islands).
11. *Aplonis brunnescens* Sharpe. Savage Island.
12. *Aplonis atrifusca* Peale. Samoa Islands.
13. *Aplonis brevirostris* Peale. Samoa Islands.
14. *Aplonis cinerascens* Hartl. & Finsch. Rarotonga, Cook Islands.
15. *Aplonis inornata* Sharpe. Raiatea, Society Islands.
16. *Aplonis kittlitzi* Finsch. & Hartl. Carolines, Ponapé, Kuschai, Ruk and Lugunor.
17. *Aplonis pelzelni* Finsch. Interior mountains of Ponapé.

Family Ploceidæ.

Subfamily *Viduinæ.*

Genus *Erythrura* Swainson, 1837.

1. *Erythrura prasina* Sparrm. From Southern Tenasserim, down the Malayan Peninsula to Sumatra, Java and Borneo.

[43] Sharpe, R. Bowdler. Catalogue of the Passeriformes, or Perching Birds in the collection of the Brit. Mus. Sturniformes. London, 1890, p. 125--137, p. 380--387. Catalogue of the Birds in the Brit. Mus., Vol. XIII. London, 1890.

2. *Erythrura forbesi* Sharpe. Tenimber Islands.

3. *Erythrura tricolor* Vieill. Timor.

4. *Erythrura trichroa* Kittl. Ternate, New Guinea, Carolines, Solomon Islands.

5. *Erythrura psittacea* Gmel. New Caledonia.

6. *Erythrura cyaneifrons* E. L. Layard. Lifu, Loyalty Islands, Tanna, New Hebrides.

7. *Erythrura serena* Scl. Island of Aneitum, New Hebrides.

8. *Erythrura regia* Scl. Island of Api, New Hebrides.

9. *Erythrura pealii* Hartl. Reva, Taviuni, Fiji Islands.

10. *Erythrura kleinschmidti* Finsch. Viti Levu, Fiji Islands.

11. *Erythrura cyanovirens* Peale. Samoa Islands.

Of the seventeen species of Aplonis only one, *A. cantor* Müll., has a more extensive distribution. It extends from Mysol, Salavati, Batanta, small islands at the west end of New Guinea, through New Guinea and the Louisiade Islands, and from the Admiralty Islands, New Britain and Duke of York Island to the Solomon Islands. *A. fuscus* Gould, occurs on Norfolk and Lord Howe's Island. The other fifteen species are restricted to special localities: Tenimber Islands; Fead Island; New Hebrides; Loyalty Islands; New Caledonia, with Isle of Pines; Fiji Islands and Rotumah Island; Tonga Islands; Fortuna Island; Savage Island; two Samoan Islands; Rarotonga Island; Raiatea, Society Islands; Carolines: Ponapé, Kuschai, Ruk and Lugunor; Interior mountains of Ponapé.

The genus Erythrura Swainson, also shows a very interesting distribution; *E. prasina* Sparrm., is found from southern Tenasserim, down the Malayan Peninsula to Sumatra, Java and Borneo; *E. trichroa* Kittl., on the Moluccas, New Guinea, Carolines and Solomon Islands; *E. cyaneifrons* E. L. Layard, on the Loyalty Islands and the New Hebrides. The remaining eight species have special localities: Tenimber Islands; Timor; New Caledonia; Island of Aneitum, New Hebrides; Island of Api, New Hebrides; Rewa, Taviuni, Fiji Islands; Viti Levu, Fiji Islands; Samoa Islands.

The peculiar differentiation of Aplonis and Erythrura on the different groups of islands can only be explained by their continental origin.

The distribution of the genus Myzomela of the Honey-eaters or Honey-suckers may next be considered.

Group CINNYRIMORPHÆ.[44]

Family *Meliphagidæ.*

Subfamily *Myzomelinæ.*

Genus *Myzomela* Vigors and Horsfield, 1826.

1. *Myzomela chloroptera* Walden. Celebes.
2. *Myzomela wakoloensis* H. O. Forbes. Island of Bourou.
3. *Myzomela simplex* Gray. Halmahera Group.
4. *Myzomela rubrobrunnea* Meyer. Misori Island in the Bay of Geelwink.
5. *Myzomela rubrotincta* Salvad. Obi Island.
6. *Myzomela boiei* S. Müller. Banda Islands.
7. *Myzomela vulnerata* S. Müller. Timor.
8. *Myzomela annabellæ* Sclater. Tenimber Group: Loetoer Island.
9. *Myzomela adolphinæ* Salvad. New Guinea, Arfac Mountains.
10. *Myzomela rosenbergi* Schleg. New Guinea: Astrolabe Mountains.
11. *Myzomela eques* Less. New Guinea, Dorey and Mysol Island.
12. *Myzomela nigrita* Gray. Western and Southern New Guinea and Aru Islands.
13. *Myzomela erythrocephala* Gould. Northern Australia to Aru Islands and New Guinea.
14. *Myzomela forbesi* Ramsay. Woodlark Islands, north of Louisiade Islands.
15. *Myzomela guentheri* Gadow. New Britain.
16. *Myzomela cineracea* Scl. New Britain.
17. *Myzomela cruentata* Meyer. New Guinea, New Ireland, New Britain.

[44] Gadow, Hans. Catalogue of the *Passeriformes*, or Perching Birds, in the collection of the British Museum. *Cinnyrimorphæ* containing the Families Nectariniidæ and Meliphagidæ (Sun-Birds and Honey-Eaters). London, 1884, p. 128--144. Catalogue of the *Birds* in the British Museum, Vol. IX, London, 1884.

18. *Myzomela sclateri* Forbes. Palakuru Island, off New Britain.

19. *Myzomela sanguinolenta* Creeper. Australia.

20. *Myzomela nigra* Gould. Greater part of Australia.

21. *Myzomela pectoralis* Gould. North Australia.

22. *Myzomela obscura* Gould. North Australia and opposite parts of New Guinea.

23. *Myzomela pulcherrima* Ramsay. Solomon Islands, Ugi.

24. *Myzomela cardinalis* Gmel. New Hebrides.

25. *Myzomela caledonica* Forbes. New Hebrides to New Caledonia.

26. *Myzomela jugularis* Peale. Fiji Islands.

27. *Myzomela nigriventris* Peale. Samoa Islands.

28. *Myzomela rubrata* Less. Caroline Islands.

29. *Myzomela chermesina* Gray. Caroline Islands, Ponapé Island, New Hebrides, Rotumah (north of Fiji).

Myzomela has a very extensive distribution, reaching from Celebes over the Moluccas, Papuan Islands, New Guinea to Australia. From New Britain and New Ireland (Bismarck Archipelago) to the Solomon Islands, New Hebrides, New Caledonia, Fiji, Samoa Islands, Rotumah, Carolines.

Of the 29 species, 21 are restricted to special localities. Here we have again the peculiar differentiation, which can only be explained by former land connection.

Subfamily *Zosteropinæ*.

Genus Zosterops Vigors & Horsfield,[44] 1827.

The genus Zosterops has the most remarkable geographical distribution. *Range:* All over Africa south of the Sahara; Island of St. Thomas and Prince's Island in the Bight of Benin, W. Africa; Socotra; Madagascar; the Mascarene Islands; Comoro; Glorioso; Seychelles Islands; entire Indian peninsula and Ceylon; Burmese countries; the whole of China, extending into Amoor Land; Japan; Formosa; Hainan; Malay peninsula; all the Indo-Malayan islands; Moluccas; New Guinea and adjacent Papuan Islands; throughout the

[44] Gadow, l. c., p. 146--203.

islands of the Pacific Ocean (with a few exceptions); New Caledonia; Lord Howe's Island; Norfolk Island; Australia with Tasmania, New Zealand, Chatham Islands.

Gadow enumerated in 1884 eighty-five species of Zosterops. The number of species known to-day must certainly be much greater. The differentiation into species is very remarkable, and a great many are restricted to single islands. I mention the following species.

1. *Zosterops cærulescens* Lath. Australia; New Zealand; Chatham Island.

2 and 3. *Zosterops albigularis* Gould and *Z. tenuirostris* Gould. Norfolk Island.

4. *Zosterops strenua* Gould. Lord Howe's Island.

5. *Zosterops tephropleura* Gould. Lord Howe's Island.

6. *Zosterops griseonata* Gray. New Caledonia and Erromango, New Hebrides.

7. *Zosterops vatensis* Tristr. Vate, New Hebrides.

8. *Zosterops flavifrons* Lath. Aneitum, Erromango, New Hebrides.

9. *Zosterops inornata* E. L. & C. L. Layard. Lifu, Loyalty Islands.

10. *Zosterops minuta* E. L. & C. L. Layard. Lifu, Loyalty Islands.

11. *Zosterops melanops* Gray. Loyalty Islands.

12. *Zosterops flaviceps* Peale. Levuka, Ovalau, Taviuni, Fiji Islands.

13. *Zosterops explorator* Layard. Kandavu, Levuka, Ovalau, Fiji Islands.

14. *Zosterops hypolais* Hartl. & Finsch. Island of Uap, Mackenzie Group.

15. *Zosterops oleagina* Hartl. & Finsch. Island of Uap, Mackenzie Group.

16. *Zosterops cinerea* Kittl. Kushai Island, E. Carolines.

17. *Zosterops ponapensis* Finsch. Island of Ponapé, Carolines.

18. *Zosterops semperi* Hartl. & Finsch. Eastern and Central Carolines; Pelew Islands.

19. *Zosterops finschii* Hartl. Pelew Islands.

20. *Zosterops conspicillata* Kittl. Island of Guam, Ladrones.
21. *Zosterops rendovæ* Tristram. Island of Rendova, Solomon Islands.
22. *Zosterops hypoxantha* Salvad. New Britain.
23. *Zosterops griseotincta* Gray. Louisiade Islands.
24. *Zosierops xanthochroa* Gray. New Caledonia and the Isle of Pines.
25. *Zosterops grayi* Wall. Ké Islands, Moluccas.
26. *Zosterops aureigula* Salv. Island of Jobi, Bay of Geelwink, N. W. New Guinea.
27. *Zosterops chloris* Bonap. Banda Island, Moluccas.
28. *Zosterops buruensis* Salvad. Island of Bouru, Moluccas.
29. *Zosterops uropygialis* Salvad. Little Ké Island, Moluccas.
30. *Zosterops atriceps* Gray. Island of Batchian, Moluccas.
31. *Zosterops fuscifrons* Salvad. Halmahera, Moluccas.
32. *Zosterops mysoriensis* Meyer. Misori Bay of Geelwink, N. W. New Guinea.
33. *Zosterops longirostris* Ramsay. Heath Island, southeastern end New Guinea.
34. *Zosterops griseiventer* Sclater. Tenimber Islands.
35. *Zosterops citrinella* Bonap. Timor.
36. *Zosterops muelleri* Hartl. Timor.
37. *Zosterops aureifrons* Wallace. Flores and Sumbawa.
38. *Zosterops gallio* Salv. Java.
39. *Zosterops javanica* Horsf. Java.
40. *Zosterops fallax* Gadow. Java and Sumatra.
41. *Zosterops frigida* Hartl. Sumatra.
42. *Zosterops atricapilla* Salv. Mount Singalan, Sumatra.
43. *Zosterops chlorates* Hartl. Mount Dempo, Sumatra, 8000 feet.
44. *Zosterops flava* Horsf. Java, Sumatra and Borneo. Bornean specimens lighter.
45. *Zosterops atrifrons* Wallace. Celebes.
46. *Zosterops everetti* Tweed. Philippine Islands: Dinagat.
47. *Zosterops meyeni* Bonap. Philippine Islands: Luzon.
48. *Zosterops japonica* Temm. & Schleg. Japan.
49. *Zosterops ceylonensis* Holdsw. Hills of Ceylon.

50. *Zosterops palpebrosa* Temm.[45] All over India from the Himalayas to Ceylon with the Laccadives; Burmese countries eastwards into South China; Andamans and Nicobars.

51. *Zosterops abyssinica* Guérin. Socotra Island, also Abyssinia, 3000–10,000 feet high.

52. *Zosterops anjuanensis* E. Newton. Comoro group: Anjuan and Grand Comoro Islands.

53. *Zosterops madagascariensis* Gmel. Madagascar and Glorioso Islands.

54. *Zosterops kirki* Shelley. Grand Comoro Island.

55. *Zosterops modesta* E. Newton. Seychelles.

56. *Zosterops semiflava* E. Newton. Seychelles: Marianne Island.

57. *Zosterops mayottensis* Schleg. Island of Mayotte.

58. *Zosterops mauritiana* Gmel. Mauritius.

59. *Zosterops borbonica* Gmel. Bourbon or Island of Réunion.

60. *Zosterops olivacea* Linn. Bourbon or Réunion'

61. *Zosterops chloronota* Gray. Mauritius.

62. *Zosterops lugubris* Hartl. Island of S. Thomas in the Bay of Biafra, W. Africa.

63. *Zosterops leucophæa* Hartl. Isla do Principé in the Bay of Biafra, W. Africa.

64. *Zosterops ficedulina* Hartl. Isla do Principé in the Bay of Biafra, W. Africa.

Of the 85 species of Zosterops mentioned by Gadow, 61 are restricted to special localities, and of these 58 to special islands or island groups. This genus traverses Africa from the west (islands in the Bay of Biafra) to the east (Abyssinia and Socotra). It is found on all the islands on the southeast coast of Africa, Madagascar, Comoro Islands, Grand Comoro, Island of Mayotte, Glorioso Islands, the Mascarenian Islands, Bourbon and Mauritius, Aldabra and the Seychelles. The next localities eastwards are the Laccadives, Ceylon, the whole of India with the Himalayas; then follow the Burmese countries to south-

[45] Gadow believes that all the specimens from these localities belong to *Z. palpebrosa* Temm. It would be strange if this species is different from the others, which have often very restricted localities.

ern China and north to southern Amoor Land; it occurs also on the Andaman and Nicobar Islands. Japan has a peculiar species, but the greatest differentiation is found on the Sunda Islands, Celebes and especially the Moluccas, and the numerous small islands and groups of islands known as the Papuan Islands. From New Guinea Zosterops ranges over to Australia, Tasmania, New Zealand and the Chatham Islands. Peculiar species are found on Lord Howe's (2) and Norfolk Islands (2); New Caledonia, the Loyalty Islands (3); New Hebrides (2); Fiji Islands (3); Carolines (3); Mackenzie Group (2); Pelew Islands; Ladrones; Solomon Islands: Rendove; Louisiade Islands; New Britain.

The extensive distribution of Zosterops and the very great differentiation into many species on islands which are often close together, or separated by very great distances from each other, can only be explained by postulating the existence of a former continent.

(*To be continued.*)

EDITOR'S TABLE.

THE meeting of the British Association, held in Toronto in August, was a success in every respect. The attendance (some 1300) was large, the addresses were good and many of the papers read were important, while the city of Toronto outdid itself in entertaining its guests. The way in which the spirit of the Victorian Jubilee was manifested was noticeable, and the guests could not but realize that they were attending the meeting of a British Association. We do not mean to infer by this that the guests were made uncomfortable, but that the national feeling could not help showing itself, in spite of such utterances as those of Sir John Evans in his Presidential Address, when he said:

"Our gathering this year presents a feature of entire novelty and extreme interest, inasmuch as the sister association of the United States of America—still mourning the loss of her illustrious President, Professor Cope—and some other learned societies have made special arrangements to allow of their members coming here to join us. I need hardly say how welcome their presence is, nor how gladly we look forward to their taking part in our discussions and aiding us in an inter-

JAMES ELLIS HUMPHREY.

See page 920.

change of thought. To such a meeting the term 'international' seems almost misapplied. It may rather be described as a family gathering, in which our relatives, more or less distant in blood, but still intimately connected with us in language, literature and habit of thought, have spontaneously arranged to take part."

Our space will not allow us to print a list of the papers presented nor to reproduce in full the various valuable addresses given. Any summary or abstract would do injustice to some of the most scholarly summaries of progress which we have ever known. As these are presented in full in both *Science* and *Nature*, the limitations of our pages are the less to be regretted. We may, however, indulge in a few notes upon matters suggested by the meetings and by the addresses given.

Naturally the contrasting features of the two associations come first to mind. In some respects our association seems the better, in others we have something to learn from our transatlantic cousins; while in still other features the two organizations are essentially identical. Thus both are subdivided into sections (the sections, however, not having the same limits in the two). These sections listen to papers and to Presidential Addresses, and the association, as a whole, is offered numerous entertainments, junkets, and the like, by its hosts.

It is not necessary to detail the points in which we think our own association is the better, but we may be pardoned if we point out some features in which we think the British Association superior to our own.

In the first place the Presidental Addresses delivered before the British Association strike us as, on the whole, better than those with which our audiences are greeted. While now and then an American address will rise to as high a standard as anything that Great Britain can boast, theirs are on the average the more thoughtful and scholarly, while ours too often have a prefunctory air and lack in breath of view.

In personnel of those who attend, the British Association again has the advantage. In England it is the fashion to attend these annual meetings, and no one there has reached such a pinnacle of greatness that he can afford to ignore or neglect this national society. As a result, at their gatherings one can be reasonably certain of meeting most of those who are the leaders in English scientific thought. In America, on the other hand, the tendency is in the other direction. It would be an easy matter to give a considerable list of names of those prominent in American science, whose faces are never seen at the association meetings.

In England many of the local scientific societies are affiliated with the British Association and send their delegates regularly to the meetings. This year, as in years past, there was a conference of these delegates, and Professor Miall, of Leeds, made some remarks before them, which seem to us so suggestive and so valuable that we must make them the text for a short digression from our main subject.

One who is at all familiar with the material which is constantly submitted for publication in our scientific journals soon realizes that there is an immense amount of wasted, or misdirected energy among the scientifically inclined. Naturally these persons attack the most prominent questions—questions far beyond their capacities, or at least beyond their facilities for doing good work. As we once heard it expressed, only the editor of a scientific periodical can realize how many second class men write upon first class problems. Now there is work, good and valuable work, which these willing individuals can do. In most cases they are removed from library facilities and large collections; not unfrequently they are ignorant of all languages except their mother tongue. They are good observers, have good reasoning powers, but are the victims of their environment. It was to such provincial naturalists that Professor Miall spoke, and he advised them to turn their attention to the study of the life-histories of the common forms about them, and to his every word we say a hearty "amen." We know too little about our intimate neighbors; we are too apt to think that some form from the interior of Africa or from some remote island of the South Seas is far more interesting, far more important, than those objects which we see every day. Yet these forms often possess extreme interest. We have only to think how glad our European fellow workers are to get our ganoids and our Limulus, to realize that we have important animals and plants in our own country. This study of the life-histories needs no library, no collections, no acquaintance with foreign tongues. It needs only a pair of sharp eyes to turn out work which shall be as full of interest and as valuable as the classic paper of Smeathman upon the white ants. That our most familiar forms will reveal new and unsuspected points of interest, is evidenced by Dr. H. H. Wilder's recent discovery that, contrary to all our text books, several of our salamanders are lungless. One cannot read the pages of the late W. H. Gibson, without realizing that there is much to be found out about the animals and plants about our very doors; and every new fact about the commonest form is a positive contribution to knowledge.

But *revenons á nos moutons.* Is it not possible for some of our smaller local societies to become affiliated with the American Association in such a way as to be productive of mutual assistance? Cannot the association act as a medium of intercourse and of exchange of ideas? Cannot the members of these societies have conferences similar to those which take place in England? We are aware that what have been termed "affiliated societies" meet with the American Association, but these societies are not the ones to which we refer. We are also aware that the Society of Naturalists started out with a somewhat similar idea. It was dropped by that organization, not because there was no need of it, but for other reasons.

Again, the British Association annually appropriates large sums (this year $7,750) in aid of various scientific investigations. Our association has recently entered upon a similar course, but so far its appropriations have been small. To the statement that it appropriates all that it can, there is a ready reply. Look at the annual report of the expenditures of the association and you will find chances for economy. Read through one volume of the "Proceedings" and you will conclude that that portly annual volume could be reduced in size without the slightest loss to science. The money saved by this could be very advantageously used in other ways, and it would not be insignificant in amount.

Where all the addresses were so good it seems somewhat invidious to select one as especially noteworthy, but the review of thirteen years progress in physiology by Professor Michael Foster, seems to the nonphysiological writer as, perhaps, the most striking and suggestive. We call it up however, not for the purpose of making any comparisons, but for the purpose of quoting from it one portion which seems especially timely after the recent attempts to get Congress and the Legislatures of Massachusetts and other States to pass anti-vivisection laws. When one knows the misstatements and perversions—to use no harsher term —of the advocates of these bills, it is a pleasure to be able to quote a direct reply to one of their deliberate misrepresentations. In his concluding remarks Professor Foster said:

"And I will be here so bold as to dare to point out that this development of his science must, in the times to come, influence the attitude of the physiologist towards the world, and ought to influence the attitude of the world towards him. I imagine that if a plebiscite, limited even to instructed, I might almost say scientific men, were taken at the present moment, it would be found that the most prevalent conception of physiology is that it is a something which is in some way an appen-

dage to the art of medicine. That physiology is, and always must be, the basis of the science of healing is so much a truism that I would not venture to repeat it here were it not that some of those enemies, alike to science and humanity, who are at times called anti-vivisectionists, and whose zeal often outruns, not only discretion, but even truth, have quite recently asserted that I think otherwise. Should such a hallucination ever threaten to possess me, I should only have to turn to the little we yet know of the physiology of the nervous system and remind myself how great a help the results of pure physiological curiosity—I repeat the words, pure physiological curiosity, for curiosity is the mother of science—have been, alike to the surgeon and the physician, in the treatment of those in some way most afflicting maladies, the diseases of the nervous system. Now physiology is, and always must be, the basis of the science of healing; but it is something more. When physiology is dealing with those parts of the body which we call muscular, vascular, glandular tissues and the like, rightly handled she points out the way not only to amend that which is hurt, to repair the damages of bad usage and disease, but so to train the growing tissues and to guide the grown ones as that the best may be made of them for the purposes of life. She not only heals, she governs and educates. Nor does she do otherwise when she comes to deal with the nervous tissues. Nay it is the very prerogative of these nervous tissues that their life is above that of all the other tissues, contingent on the environment and susceptible of education. If increasing knowledge gives us increasing power so to mould a muscular fibre that it shall play to the best the part which it has to play in life, the little knowledge we at present possess gives us at least as much confidence in a coming far greater power over the nerve cell. This is not the place to plunge into the deep waters of the relation which the body bears to the mind, but this at least stares us in the face, that changes in what we call the body bring about changes in what we call the mind. When we alter the one, we alter the other. If, as the whole past history of our science leads us to expect, in the coming years a clearer and clearer insight into the nature and conditions of that molecular dance which is to us the material token of nervous action, and a fuller, exacter knowledge of the laws which govern the sweep of nervous impulses along fibre and cell, give us wider and directer command over the moulding of the growing nervous mechanism and the maintenance and regulation of the grown one, then assuredly physiology will takes it place as a judge of appeal in questions not only of the body, but of the mind; it will raise its voice not in the hospital and consulting-room only, but also in the Senate and the school."

We have received notice of the recent formation at New Orleans of "The Louisiana Society of Naturalists" with Prof. J. H. Dillard, of Tulane University, as President, and Mr. E. Foster, Secretary. The Society has already about 45 members, nearly all of whom are workers in some branch of natural science. It proposes to work up the fauna and flora of the State in a systematic manner, a task never before attempted. One has only to look at the map of Louisiana—possessing the mouth of one of the largest rivers in the world, numerous bayous, vast salt and freshwater lakes, large islands and bars, extensive swamps and forests—to see what grand possibilities are in store for this society if its members will study geographical distribution in the broad and yet detailed way in which it is done by the Biological Survey of the Department of Agriculture. We hope to receive reports from time to time of the results achieved by the society.

General Notes.

BOTANY.

Pfaff's Observations on the Nature of Ivy Poisoning.—Considering the frequency of Rhus poisoning and the abundance of our two noxious species, it is remarkable that the exact nature of the irritant has so long eluded discovery. The most widely divergent views upon the subject have from time to time been advanced. Khittel, in 1858, regarded the poisonous principle a volatile alkaloid; Maisch, in 1865, believed it a volatile acid; while Burrill at one time thought a bacterial germ might be the responsible agent. However, none of these observers has made a very satisfactory case, and it is accordingly a matter of more than ordinary interest that the poisonous principle has at length been isolated by Dr. Franz Pfaff, of the Harvard Medical School. As Dr. Pfaff's preliminary article[1] upon the subject is published in a medical journal and may, therefore, escape the notice of biologists who are not also physicians, his results may be summarized in these columns.

After a résumé of the investigations on Rhus poisoning, the fact is pointed out that skin irritants are, in general, rapid or slow in their

[1] Journal of Experimental Medicine, II, 181–195, t. 10.

action according as they are more or less volatile. In the case of Rhus poisoning the latent period between exposure and the first symptoms of dermatitis, is a comparatively long one, amounting often to several days. This would suggest that the poison is not a volatile substance but something of a more fixed nature. However, as the prevailing opinion strongly favored the idea that Rhus poison pervaded the air in the neighborhood of the plant, Dr. Pfaff first proceeded to extract by steam distillation Maisch's "toxicodendric acid," which after combination with barium and sodium was found to be nothing more nor less than acetic acid. He then tried quite a different plan and by distilling alcoholic extracts of *Rhus toxicodendron* and *R. venenata* he obtained a black oily residue, which when purified gave an oil of agreeable odor. This oil was readily soluble in alcohol, ether, benzol, etc., but insoluble in water. On prolonged exposure to air it turned to a resin. The effects of the oil, for which the appropriate name *Toxicodendrol* is suggested, were repeatedly tried upon the persons of several assistants and others offering themselves as subjects. In all cases it proved a most active skin irritant, producing, even when applied in very small quantities, highly characteristic cases of Rhus poisoning. There can, therefore, be scarcely a doubt that the true principle has now been discovered.

Notwithstanding the popular impression that a volatile poison eminates from the Rhus, which thus acts upon sensitive persons even at a distance, no signs of such action have been detected by Dr. Pfaff and his assistants. Although they have experimented upon many pounds of fresh *R. toxicodendron* and *R. venenata*,, no case of poisoning has occured except after actual contact with the plants or with objects which the plants have touched. Dr. Pfaff suggests that the pollen may at the time of anthesis act as a transporting agent, but that the popular opinion has probably arisen through frequent cases of poisoning by unconscious contact with the plants or with clothing or other objects to which the viscid oil has adhered. The extended latent period, of course, adds greatly to the difficulty of eliminating such possibilities in particular cases. The practical outcome of Dr. Pfaff's discoveries is that we may now have an intelligent treatment in cases of Rhus poisoning, and he points out that the best remedy at all stages is the very simple one of removing the irritant by thoroughly brushing the affected parts with soap and water, while on the other hand, the application of oils, vaseline, or even alcohol, if not at once removed, only serves to spread the poisonous principle, since it is readily soluble in these media.

The newly discovered toxicodendrol appears to be present in all parts of the plant, even in the roots. Old and dried stems also yielded it. No difference has as yet been detected between the oil extracted from *Rhus toxicodendron* and that from *R. venenata.* Successful analyses have not yet been made, but further investigations along these lines are in progress in Dr. Pfaff's laboratory. It is to be hoped that he will extend his researches to other species of Rhus, notably *R. pumila* Michx., concerning which there has been considerable controversy, some writers maintaining its innocence, others its extreme virulence.—B. L. ROBINSON.

Botany in Detroit.—The botanists appeared to share the feeling of many other scientific men that it was inadvisable to hold a separate meeting of the American Association for the Advancement of Science, preferring to arrange for a joint meeting with the British Association which met a week later in Toronto. At any rate, the botanists pretty generally did not go to Detroit. When Section G organized on Monday forenoon, there were in addition to the Vice-President and Secretary but three duly qualified members who were eligible to appointment upon the sectional committee, and it was not until the second day that all the committees were filled. And yet in spite of this discouraging beginning, the sessions were interesting and profitable.

Vice-President Atkinson delivered his address upon "Experimental Morphology" on Monday afternoon, August 9th, detailing with some particularity the results of his experiments upon ferns of the genus Onoclea, in which by mutilation at certain periods he was able to bring about the transformation of the sporophyll into a normal or nearly normal foliage leaf. The possibility of applying experimental methods to the solution of many morphological problems was discussed at some length.

The following papers were presented, some in extenso and others by title only.

Trillium grandiflorum, its variations, normal and teratological, by Charles A. Davis.

A discussion of the structural characters of the order Pezizinæ of Schroeter, by J. E. Durand.

The taxonomic value of fruit characters in the genus Galium, by K. E. Wiegand.

Report upon the progress of the botanical survey of Nebraska, by Charles E. Bessey.

Changes during winter in the perithecia and ascospores of certain Erysipheæ, by B. T. Galloway.

The Erysipheæ of North America, by B. T. Galloway.

Some contributions to the life-history of Haematococcus, by L. R. Jones.

Bacteriosis of Carnations, by Albert F. Woods.

Wakker's Hyacinth bacterium, by Erwin F. Smith.

Notes on some new genera of fungi, by George F. Atkinson.

Are the trees receding from the Nebraska plains ?, by Charles E. Bessey.

Reproductive organs and embryology of Drosera, by C. A. Peters.

Development of some seed-coats, by J. O. Schlatterbeck.

Contributions on the wild and cultivated roses of Wisconsin and neighboring States, by J. H. Schuette.

Morphology of the flower of *Asclepias cornuti* by Fanny E. Langdon, presented by V. M. Spalding.

Comparison of the pollen of Pinus, Taxus and Peltandra, by George F. Atkinson.

Some characteristics of the foothill vegetation of western Nebraska, by Charles E. Bessey.

On the distribution of starch in woody stems, by B. Shimek.

Mechanism of root-curvature, by J. B. Pollok, presented by V. M. Spalding.

The toxic action of phenole in plants, by R. H. True and C. G. Hunkel.

Cellulose ferment, by F. C. Newcombe.

Is the characteristic acidity of certain species of the Arum family a mechanical or a physiological property or effect, by Charles P. Hart.

How plants flee from their enemies, by W. J. Beal.

Stomata on the bud-scales of *Abies pectinata,* by A. P. Anderson.

Comparative anatomy of the normal and diseased organs of *Abies balsamea* affected with *Aecidium elatinum,* by A. P. Anderson.

On a new and improved self-registering balance, by A. P. Anderson.

Several other papers were presented, the titles of which were not obtained, and two hours were given to a joint session with the Zoological Section in the discussion of Organic Selection as presented by H. F. Osborn.

In the Botanical Club, it was found on assembling, that President, Vice-President and Secretary were absent; accordingly J. J. Davis was elected President, and Albert F. Woods, Secretary. The following notes were presented :

An epidemic of *Erysiphe communis* on *Polygonum aviculare,* by Charles E, Bessey, noting the universal presence of this parasite upon the host mentioned in eastern Nebraska in 1897.

A phosphorescent mosquito (Chironomus sp.), by Charles E. Bessey, noting phosphorence upon all parts of the insect which, while living, was evidently suffering from some disease. No hyphæ or bacteria were found after careful examination, although the presence of the latter is suspected.

Photographs of the Botanical Gardens of the Michigan Agricultural College were shown by W. J. Beal.

Charts of fungi and large sheets of preparations of weeds, to be used in botanical lectures before distant audiences were shown by W. J. Beal.

Dicranum spurium and some other mosses, by R. H. True, noting certain structural peculiarities.

Sensitive stamens in Opuntia, by Charles E. Bessey, (*O. fragilis* and *O. missoouriensis*).

Some south Michigan Oaks, by Messrs. Britton and Wheeler, being the report of a committee which visited some oaks near the city. The trees in question *may* belong to the species *Quercus texana* and *Q. michauxii*, but further study is necessary.

On a method of preserving chlorophyll-bearing tissues, by A. F. Woods. After precipitating the chlorophyll with copper, the material (as leaves, etc.) may be preserved indefinitely in glycerine jelly.

Why moss-capsules nod, by R. H. True, concluding that while the curvature is geotropic, the direction is influenced by light.

The botanical garden of the University of Michigan was spoken of by V. M. Spalding.

Frost injury to fruit trees and the falling of Ailanthus leaves were discussed by A. D. Selby.

Professor Conway MacMillan, of the University of Minnesota, Minneapolis, Minnesota, was elected President for the ensuing year.

Professor C. B. Waldron, of the University of North Dakota, Fargo, N. D., Vice-President.

A. B. Seymour, Harvard University, Cambridge, Mass., Secretary.

CHARLES E. BESSEY.

The Botanical Society of America held its third Annual Meeting in Toronto, August 17th and 18th. The address of the retiring President, Prof. C. E. Bessey, upon the Phylogeny and Taxonomy of the Angiosperms, will be published in full by the Society. The following papers were read:

B. L. Robinson: Ecblastesis in *Lepidium apetalum.*

J. C. Arthur: Movement of protoplasm in cœnocytic hyphæ.

J. M. Coulter: The pollen grain and the antipodal region.

D. P. Penhallow: Studies of the species of Picea.

H. J. Webber: The fertilization of Zamia.

D. T. McDougal and D. H. Campbell: Report upon the proposed tropical laboratory.

E. L. Greene: Bibliographical difficulties.

The following officers were elected for the ensuing year: President, Dr. N. L. Britton; Vice-President, Prof. J. C. Arthur; Secretary, Prof. C. R. Barnes; Treasurer, Arthur Hollick. The next meeting will be held in Boston just previous to the meeting of the American Association for the Advancement of Science.

Government Timber-tests.—The Division of Forestry of the United States Department of Agriculture issued some months ago a summary of mechanical tests on thirty-two species of American woods (Circular 15) which is worthy of something more than a passing remark. These tests were made in St. Louis, Mo., by Professor J. B. Johnson. This work has been carried on for six years, resulting in the collection of a great deal of valuable information in regard to the timbers investigated. The work thus far has been very carefully done, and the results cannot but prove of the greatest value to engineers and others who make use of timber for large constructions. It is a pity that the Chief of the Division has to say "at the present writing all work in timber-testing has been abandoned." It is to be hoped that the Secretary of Agriculture will make strenuous efforts to secure the means for continuing the work. Certainly our American timbers are worthy of being carefully studied, and having their values rated in standard works on the strength of materials. A Secretary who wishes to bring things American to the favorable notice of the world could not do it more certainly than by securing the exact data demanded by engineers as to the value of our native timbers.—Charles E. Bessey.

Notes.—J. M. Greenman, of the Gray Herbarium of Harvard University, contributes three papers to the Proceedings of the American Academy of Arts and Sciences (Vol. XXXII, No. 16), namely, a Revision of the Mexican and Central American Species of Houstonia, a Key to the Mexican Species of Liabum, and Descriptions of new or little-known Plants from Mexico.

Among the recent papers on mosses is an important one by J. Cardot on the Mosses of the Azores and of Madeira, in the Eighth Annual Report of the Missouri Botanical Garden. It includes twenty-four

pages of text, consisting of an annotated catalogue with descriptions of new species, and eleven plates.

Dr. J. C. Arthur's bulletin (65, Purdue) on Formalin for prevention of Potato Scab, shows that by the use of this substance "seed-potatoes" may be practically freed from scab germs by an immersion for two hours in a solution of the approximate strength of 1:300.

In a recent number of the Journal of School Geography, Professor Conway MacMillian contributes some useful notes for teachers on the Geographical Distribution of Plants. Copies can probably be obtained of the author by addressing him at the University of Minnesota.

Professor G. B. Frankforter, of the University of Minnesota, has begun the chemical study of the common poke-weed (*Phytolacca decandra*), and has published the first part of his results in the American Journal of Pharmacy. Among the results thus far obtained is the remarkably high per cent. (41.62) of potassium oxide found in the ash.

From the Experiment Station Record we learn that the following amounts were included in the Congressional appropriations for the United States Department of Agriculture for the fiscal year 1897–8, viz.: Division of Botany, $23,800; Division of Agrostology, $18,100; Division of Forestry, $28,520; Division of Vegetable Physiology and Pathology, $26,500. This is hopeful; nearly $100,000 for the study of some phase of botanical science! But one is disappointed in finding that Congressmen have wasted $130,000 for a free distribution of seeds. We hoped that the day of this unwisdom had passed.—Charles E. Bessey.

ZOOLOGY.

A List of the Birds of the Vicinity of West Chester, Chester Co., Pennsylvania.—(*Continued from page 814.*)—

106. *Dendroica æstiva* (Gmel.), Yellow Warbler. Rather common summer resident, but more abundant during the migration period. (Earliest spring occurrences: May 5, 1888; May 14, 1889).

107. *D. cœrulescens* (Gmel.), Black-throated Blue Warbler. Abundant migrant. (Spring occurrences: May 14, 1887; May 9–12, 1888; May 11, 1889; May 9, 1891. Fall occurrences: Sept. 7–29, 1889; Sept. 23 to Oct. 5, 1890).

108. *D. coronata* (Linn.), Myrtle Marbler. The most abundant migrant of the family, unless *Compsothlypsis americana* should be assigned

that position. (Spring occurrences: April 19, 1886; May 7, 1887; May 4–19, 1888; May 3–17, 1890; April 22 to May 9, 1891. Fall occurrences: Oct. 12, 1889; Oct. 18, 1890).

109. *D. maculosa* (Gmel.), Magnolia Warbler. Common migrant in the spring and fall. (Spring occurrences: May 9–15, 1888; May 14, 1889; May 10–17, 1890; May 9, 1891).

110. *D. cœrulea* (Wils.), Cærulean Warbler. Very rare migrant. I shot a female in a swamp in West Goshen, May 10, 1890 (now in collection Acad. Nat. Sci. Philada.). I believe this to be the only published record of this species in eastern Pennsylvania, with the exception of one recentty secured in Delaware Co. Dr. B. H. Warren claims ("Birds of Pennsylvania," 2d ed., 1890) to have seen five individuals in this part of the State, but since he does not mention to have taken specimens, the identity of these cases must be questioned.

111. *D. pennsylvanica* (Linn.), Chestnut-sided Warbler. Abundant migrant in the spring and fall. (Spring occurrences: May 7, 1887; May 9, 1888; May 11, 1889; May 10–17, 1890; May 9, 1891).

112. *D. castanea* (Wils.), Bay-breasted Warbler. Infrequent migrant. I shot a male on May 11, 1889, and a male and female May 17, 1890, also a bird of the year Sept. 17, 1890.

113. *D. striata* (Forst.), Black-poll Warbler. Common migrant in the spring and fall. (Spring occurrences; May 17, 1887; May 9–27, 1888; May 11–14, 1889; May 17, 1890; May 8, 1891).

114. *D. blackburniæ* (Gmel.), Blackburnian Warbler. Tolerably common migrant in the spring and fall. (Spring occurrences: May 5–19, 1888; May 4, 1891; May 7, 1897. Fall occurrences: Aug. 28, 1888; Sept. 19, 1890).

115. *D. virens* (Gmel.), Black-throated Green Warbler. Abundant spring and fall migrant. (Spring occurrences: April 28 to May 12, 1888; April 25 to May 8, 1891. Fall occurrences: Oct. 7. 1887; Sept. 19–29, 1889; Sept. 19 to Oct. 5, 1890).

116. *D. vigorsii* (Aud.), Pine Warbler. Common migrant in the fall. (Fall occurrences: Oct. 1–8, 1887; Sept. 19, 1889; Sept. 17 to Oct. 18, 1890). No spring occurrences have been noted by me.

117. *D. palmarum hypochrysea* Ridgw., Yellow Palm Warbler. Rather infrequent migrant in the spring. I have never seen it in the fall. In April, 1891, I shot five specimens and saw a few others, and saw a single one April 25, 1897.

118. *D. discolor* (Vieill.), Prairie Warbler. Rather rare migrant, which I have seen only twice, on May 10, 1890, when I secured a female and saw two other individuals, and May 2, 1897.

119. *Seiurus aurocapillus* (Linn.). Oven-bird. Common summer resident, though more abundant during the migration periods. (Earliest arrivals: May 2, 1887; May 12, 1888; May 11, 1889; May 3, 1890; April 25, 1891. Bulk arrived: May 10, 1887; May 19, 1888; May 1, 1891).

120. *S. noveboracensis* (Gmel.), Water Thrush. I have collected only one specimen of this species, on May 10, 1890, in West Goshen.

121. *Geothlypis formosa* (Wils.), Kentucky Warbler. Infrequent summer resident. I shot a male July 29, 1888. It is considerably more frequent during the migrations.

120. *G. agilis* (Wils.), Connecticut Warbler. Infrequent migrant in the early fall; the only specimens I have found were two collected in 1889, on Sept. 20th and 28th, respectively, and I saw another on Sept. 25th (all in West Goshen).

123. *G. trichas* (Linn.), Maryland Yellow-throat. Common summer resident. (Earliest arrivals: May 9, 1888; May 3, 1890; April 24, 1891. Bulk arrived: May 7, 1887).

124. *Icteria virens* (Linn.), Yellow-breasted Chat. Infrequent summer resident. I noticed one on May 6, 1887, in West Goshen, and shot a pair (male and female) in Birmingham on July 6th of the same year. In the spring of 1897 I saw four pairs, the first of which arrived May 9th.

125. *Sylvania pusilla* (Wils.), Wilson's Warbler. Common migrant in the spring and fall. (Spring occurrences: May 18, 1886; May 12, 1888; May 10–17, 1890).

126. *S. canadensis* (Linn.), Canadian Warbler. Common migrant in the late spring and early fall. (Spring occurrence: May 19, 1888; May 11, 1889; May 10, 1890).

127. *Setophaga ruticilla* (Linn.), American Redstart. Abundant migrant in the spring and fall. (Spring occurrences: April 14 to May 17, 1886; May 7–13, 1887; May 12–19, 1888; May 10–17, 1890; April 28 to May 9, 1891. Fall occurrences: Aug. 11, 1886; Aug. 25, 1887; Sept. 20, 1889; Sept. 6–23, 1890).

128. *Anthus pennsylvanicus* (Lath.), American Pipit. Not uncommon, though of irregular occurrence in the fall and spring. (Earliest fall occurrence: Oct. 13, 1888. Latest spring occurrence: April 14, 1888, when I saw a flock of about 100).

129. *Galeoscoptes carolinensis* (Linn.), Catbird. Abundant summer resident. (Earliest spring arrivals: May 4, 1886; May 2, 1887; May 1, 1888; May 1, 1891; April 28, 1897. Bulk arrived: May 5, 1886; May 3, 1887; May 6, 1888; May 4, 1891. This species is more regu-

lar in regard to the time of its arrival than any other that I have observed.

130. *Harporhynchus rufus* (Linn.), Brown Thrasher. Common summer resident. (Earliest arrivals: April 25, 1886; April 23, 1887; April 28, 1888; April 20, 1889. Bulk arrived: April 26, 1887).

131. *Troglodytes aëdon* Vieill., House Wren. Abundant summer resident. (Earliest spring arrivals: April 22, 1886; April 27, 1887; March 31, 1888; April 17, 1891, Bulk arrived: April 29, 1887; April 4, 1888).

132. *T. hiemalis* Vieill., Winter Wren. Tolerably common winter resident. (Earliest occurrence: Sept. 25; latest occurrence, March 31).

133. *Certhia familiaris americana* (Bonap.), Brown Creeper. Tolerably common resident during the late fall, winter and early spring. (Earliest occurrence: Sept. 25, 1890. Latest occurrence: April 21, 1886).

134. *Sitta carolinensis* Lath., White-breasted Nuthatch. Common resident.

135. *S. canadensis* Linn., Red-breasted Nuthatch. A very infrequent migrant. I shot a female on April 27, 1889, and saw another individual on Sept. 29th of the same year; also a brightly colored individual on Oct. 17, 1896, and shot another April 28, 1897.

136. *Parus bicolor* Linn., Tufted Titmouse. Common migrant in the spring and fall.

137. *P. atricapillus* (Linn.), Black-capped Chickadee. Common winter resident, sometimes abundant.

138. *Regulus satrapa* Licht., Golden-crowned Kinglet. Common resident in the fall, winter and spring.

139. *R. calendula* (Linn.), Ruby-crowned Kinglet. Common migrant in the spring and fall.

140. *Turdus mustelinus* Gmel., Wood Thrush. Common summer resident.

141. *T. fuscescens* Steph., Wilson's Thrush. Not infrequent migrant. I have taken it only in the spring.

142. *T. ustulatus swainsonii* (Cab.), Olive-backed thrush. I have shot only two specimens of this species, on Sept. 9, 1887, and Sept. 2, 1895, both in West Goshen.

143. *T. aonalaschkæ pallasii* (Cab.), Hermit Thrush. Common migrant in the spring and fall. (Spring occurrences: May 17-21, 1886; April 2, 1888; May 11, 1889; April 15-28, 1891. In the fall it remains until about Nov. 15th).

144. *Merula migratoria* (Linn.), American Robin. Abundant summer resident. (Earliest spring arrivals: Jan. 26, 1887; Feb. 21, 1888; March 13, 1889; March 1, 1890; Feb. 24, 1891. Bulk arrived: March 13, 1887; March 10, 1888; March 14, 1889. Latest fall occurrences: Dec. 18, 1885; Nov. 25, 1887; Dec. 31, 1889; Nov. 1, 1890). To judge from these data, it would seem probable that a few remain through the mild winters.

145. *Sialia sialis* (Linn.), Bluebird. Common resident, but now not as numerous as at the commencement of the period of my observations. It migrates in severe winters.

—THOS. H. MONTGOMERY, JR., PH. D.

May 26, 1897, Wistar Inst. of Anat., Philada.

ENTOMOLOGY.

Scudder's Guide to the Orthoptera.[1]—Mr. Scudder has again placed the workers in systematic entomology under obligation to him, by the publication of an exceedingly useful manual of Orthoptera. This little volume consists of analytical tables, bibliographical notes, and a list of papers treating of North American Orthoptera. The scope of the work is well stated by the author in his preface as follows:

"The following tables and bibliographies are published, not as a finality, but for temporary use by students of Orthoptera in this country, who have few means for working up their collections. The author contemplates a general work on the classification of our Orthoptera, of which this is merely a prodromus, and which may serve its purpose until the material at hand has been more thoroughly studied; the frequent demands made for information have prompted it. The greater number of tables are based upon those of Stal, Brunner and de Saussure, but these authors are in no way responsible for the form in which they here appear."

The work will be warmly welcomed by all having collections of Orthoptera. For the first time, it is now possible for one not a specialist in the Orthoptera, to determine the North American genera of all families of this order.

[1] Guide to the Genera and Classification of the North American Orthoptera found north of Mexico. By Samuel Hubbard Scudder. Cambridge, Edward W. Wheeler, 1897, 8vo, pp. 89, $1.00.

If the appearance of the more general work is to be long delayed, which is probable, owing to the magnitude of the undertaking, it is to be hoped that Mr. Scudder will soon give us a catalogue of the known North American species of this order. Such a catalogue, even though it were merely provisional, would be of great use to those having collections to arrange, and would stimulate more careful collecting in regions which have not yet been thoroughly explored. In this way much would be done to hasten the day when a fairly complete general work could be published.

One has only to consider the great usefulness of our lists of Lepidoptera to appreciate the value of even an imperfect catalogue. And there is no one else so well qualified as is Mr. Scudder to prepare a catalogue of the Orthoptera.—J. H. C.

PSYCHOLOGY.[1]

Notes on the Experimental Study of Memory.[2]—The experimental investigation of memory began only a few years ago. In the books on modern psychology which date ten years back, there was no mention of it whatever. Wundt's treatise on physiological psychology, which may rightly be considered a typical work, devotes but very few pages to memory and not a word to experiments upon this faculty; nevertheless, this is a work which has passed through several editions, in which the author has endeavored to keep abreast with the science. The first investigators who directed their attention to the subject were Galton, Jacobs and Ebbinghaus; their studies were confined to a few points, and there still remain to-day many unexplored regions in this domain. The memory of sensations is merely outlined, and the memory of ideas still remains to be covered, at least for the most part. However, within the last two years, attention has been turned in the direction of the memory. Münsterberg, Calkins, Bigham, Müller and Schumann and many others have already published results which are exceedingly interesting, although still fragmentary. As it is certain that these studies are more likely than some others to render great service to pedagogy, it is to be hoped that the movement already begun will not be arrested too soon.

[1] Edited by Howard C. Warren, Princeton University, Princton, N. J.

[2] Translated and slightly abridged from the *Année Biologique*.—H. C. W.

The experiments on memory, whether made collectively on an assemblage of persons, as (*e. g.*), on an entire class of students, or individually upon single subjects, or again on the experimenter himself, who serves as his own subject—these experiments, I say, consist chiefly in giving the subject a certain impression, and then seeking to find out what becomes of this impression in his memory at the end of a certain time. The experimenter endeavors above all to take account of the greater or lesser transformation which the memory causes the impression to undergo. To discover this, three principal methods are employed.[3]

1. *Method of reproduction.*—This consists in making the subject *reproduce* his impression; if it is a story that he has listened to, he repeats or writes it; if it is a visible form, he sketches it; if it is a sound or an inflection, or some visible movement, he imitates it; if it is a color, he reproduces it by mixing the tints on a palette or varying the sectors of rotating discs. This is certainly the most natural method, in that it follows closely our ordinary procedure; but as a method of studying the memory it is somewhat indirect; it requires a translation or transposition of the impression, and a special aptitude, *e. g.*, in sketching or painting; it should, therefore, be expressly reserved for the verbal memory. 2. *Method of selection.*—This consists in the recognition of the impression when it is presented again in company with others; thus a tint is exhibited at first and the subject must remember it; at the end of a certain time he is shown a graded series of the same color, comprising fifteen different tints, and must recognize the one which was shown him before; the second presentation may give the whole series simultaneously or successively. This method is simpler than the preceding, since it bears more directly on the memory; there remains to consider the sources of error which it contains. One has already been noted. Whenever we have to make a choice from among a set of objects our attention is drawn towards the centre of the series; if the impression to be recognized is the sixth in a series of 15, the seventh impression is more apt to be indicated than the fifth, because the former is nearer the centre; consequently the arrangement of the series, that is, the application of the method, exerts some influence upon the character of the results. 3. *Method of comparison.*—The subject compares the remembered impression with another impression which is shown him, and answers that the latter is "equal, greater or smaller."

[3] This classification of the methods for the study of memory was first proposed by V. Henri and myself; Baldwin has arrived at analogous methods quite independently.

Thus if it is a line that he is to remember, he is shown another line and judges the relation of the two.

These two methods may be used with many variations of detail into which we need not enter; it is sufficient to have shown that it is possible to make an experimental study of memory. I shall proceed to indicate the principal results which have up to the present been reached by science. There is, perhaps, no question of more importance to pedagogy. As I can only give a bird's-eye view of the whole, I will not mention any name, nor will I enter into the details of any experiment; it is sufficient to sum up in a few bare statements the results that have been attained.

1. *Partial memories.*—We know to-day that the memory is not a unit, but that there exists for each individual a series of partial memories which are distinct and independent; that these memories are unequally developed, and that in a certain number of pathological cases one of the memories may disappear altogether, leaving the rest intact or nearly so. The most striking example of this that can be cited is aphasia, a disorder in which the memory and images of words are affected in a special manner; the patient usually retains the memory and images of objects, and remains in possession of his intellect. Examples of the partial development of memory are met with among some professional exhibitors, such as chess players and (more especially) lightning calculators.

2. *The measurement of memory.*—Although the methods used for measuring the memory may have been crude, as they still are, it is nevertheless a great advance to be able to introduce the concept of measurement into this problem at all. So far attempts have been made to measure but one kind of memory, the direct faculty of acquisition. The experiments deal with the number of memory-images that can be stored up at a single trial, without allowing the subject time to rest. This is called in English the "mental span" of the memory; I have proposed for it the term "faculté de prehension." Several successive investigations have already been made on the measurement of the memory for figures and syllables; these are localized memories, the development of which cannot be considered as a sign of the development of the other memories; we must, therefore, make many reservations in interpreting the conclusions to be drawn from these experiments. The experiment may be made as follows: a series of figures is read to the subject at a regular speed (the speed used is in general two figures per second) and without any special accentuation; as soon as he has heard the series, the subject, having been told beforehand of

the requirement, endeavors to repeat the figures without error and in the order in which he heard them. The experiment is repeated several times, beginning with a small number of figures, *e. g.*, four, which any adult can give correctly; it is then increased to five figures, then to six, and so on, until a number is reached which the subject can no longer repeat correctly; care is taken to repeat each trial, and to allow sufficient intervals of rest to avoid fatigue and the confusion of figures in the memory. This procedure, adopted by Jacobs, Galton and many others, has already borne fruit. It is not, properly speaking, a test of the memory alone; it is extremely difficult, be it said in passing, to experiment on any isolated psychological phenomenon; the experiments taken together show, on the contrary, that the subject employs not only his memory but also his powers of voluntary attention; this explains why children retain fewer figures by this method than adults; their inferiority is certainly due to the fact that they have less control over their attention. The average educated adult retains seven figures; a child from 6 to 8 retains five; a child of 10 retains six. A difference of one single figure is of considerable importance in the results, and it is one of the drawbacks of this method that we cannot operate with fractions of figures. I have had occasion to measure the retentive memory of Jacques Inaudi, the celebrated lightning calculator; he is able to commit more than 40 figures at one trial; it will be seen from this how far his memory is above the average.

Instead of finding out the number of figures, letters or words that can be retained by one person after a single hearing or reading, a different procedure may be adopted; we may endeavor to find the time required by different individuals to learn a given number of figures, say twelve; further, we may try to find the time necessary to learn again a series once learned and afterwards forgotten. For details in regard to these rather complex methods I refer the reader to the work of Ebbinghaus. (*Ueber das Gedächtniss*).

A rather curious question, which is closely related to that of the measurement of memory, is the *simulation* of the memory for figures. Memory can be simulated as well as other things. This is done by means of mnemonics, a process which consists in associating arbitrary ideas with figures; I have indicated, in a study undertaken with V. Henri, how real memory can be distinguished from simulated memory, by measuring the time required to learn and reproduce.

3. *Forgetfulness.*—We now reach a question that has an important pedagogical bearing: the problem of forgetfulness. In what does it consist? What is its course? What memories are attacked first?

What are the best means to adopt for preserving memory-images? What should be done in order to strengthen the memory, etc., etc.? On all these points there have accumulated within the last ten years a countless number of documents; no synthesis of these data has yet been made, and I know of no general work in which the author has attempted to compare the results of these special studies and to draw forth their underlying principles; I except, of course, works on the mental pathology of the memory (Ribot, Sollier, etc.), which we are not concerned with here; I am only speaking of normal memory, studied with exactness by means of laboratory experimentation.

The analysis of these experiments leads us to one conclusion regarding the nature of forgetfulness. It is of two kinds, and is due to two principal causes: (1) *Forgetfulness through lack of retention;* the impression is not stamped in and does not leave a trace, this is the first kind; (2) *Forgetfulness through lack of reproduction;* the impression has been stamped in, but cannot be brought out or reproduced at will. *e. g.*, 100 words being read to a person, how many does he forget? The answer varies according to the way in which the term forgetfulness is interpreted. If we ask the subject to repeat the words, he will perhaps not be able to give more than 20, hence he has forgotten 80—forgotten them, in the sense that he cannot repeat them. This number can, therefore, be placed to the credit of forgetfulness through lack of reproduction. Now if we take these 80 words which the subject cannot repeat and mixing them up with one or two hundred new words, ask him to distinguish the old from the new words, we will see that he makes a very small number of errors; I suppose that on the average 60 words will be recognized out of 80, so that in the end there are scarcely 20 words in 100 (and, perhaps, even fewer) that are completely forgotten; the others were retained, inasmuch as they were recognized. *The amount of forgetfulness through lack of retention is always small.*

The position of the forgotten elements in a series of memories appears to be quite regular; the first elements in the series are almost always better retained than the rest, no doubt because they strike the attention when it is fresh; the same is true of the last elements, no doubt because they are the ones acquired most recently; most of the forgotten elements, then, belong to the centre of the series. The influence of novelty, repetition and other factors on forgetfulness have been studied (Calkins), as well as the influence of the time elapsed (in numerous investigations), the organ stimulated, the attention, distraction, etc. These investigations, many of them minute, have furnished us with matters of detail, rather than general ideas.—ALFRED BINET.

SCIENTIFIC NEWS.

A Statement to the Corporation from the Trustees of the Marine Biological Laboratory.—The annual meetings of the corporation will hereafter be held at Woods Holl in August, instead of Boston in November, and absent members can now vote by proxy. The board of trustees has been enlarged to twenty-seven members, and the new board, it is believed, fairly represents nearly all sections of this country and Canada. The closer co-operation of all institutions of learning is now actively encouraged.

These changes will make possible the attendance of a large number of members at annual and special meetings, who have been unable to reach Boston during the month of November, and there are already signs of increasing interest in the institution over a much wider area. The members will be glad to learn that, at the recent meeting of the British Association in Toronto, Dr. Dohrn, Director of the unrivalled station at Naples, took occasion to speak as from personal knowledge in terms of warm commendation of the work at Woods Holl. The past summer has been highly satisfactory; but the trustees have been hampered by lack of funds for needed repairs and renewals, and, to some extent, for current expenses. At least $1,000 should be raised before resuming work next summer, and there remains a debt of about $4,700 incurred for the erection of new buildings. This debt should be cancelled in order that a clear balance sheet may be shown before undertaking several most desirable extensions of the plant, some of which are urgently needed. Salaries should be increased and greater inducements offered to the strong corps of instructnrs and workers, whose collaboration has enabled the institution to attain its present position in the scientific world. Moreover, there is no assurance of permanence in an institution of this nature, until it shall have acquired a sufficient endowment or maintenance fund, independent of its land, buildings and equipments (which now represents an investment of over $33,000), to relieve it from danger of extinction by one or more seasons of small attendance. The endowment fund now amounts to over $3,500, and has been carefully husbanded; but it should be increased to at least $50,000, and the special funds, the Lucretia Crocker Fund for scholarships and the library fund, may profitably be added to.

One effect of the recent changes in the by-laws will be, or may be, to diminish the special interest in and sense of responsibility for the laboratory heretofore shown in the city of Boston and its immediate

vicinity, to which, as is well known, the institution owes its initial impulse and much continuous and generous support. In appealing, as they do now, to a wider constituency, the trustees are in nowise unmindful of the debt which the cause of science and of sound learning owes to this intelligent and kindly support in the past, some of which support, as they are assured, will hereafter be extended, with unwearied generosity, from the same locality. The laboratory now looks to the country at large for its main source of income. Upon all the corporate members, in whose hands the recent changes have placed the entire control, now rests the correlative duty of supporting the work. With power comes responsibility.

The trustees, therefore, have decided to raise the annual dues of members of the corporation to two dollars ($2). The fiscal year now begins in the second Tuesday in August, and this sum is now due for the year ending August 9, 1898. Members of the corporation will kindly forward it, together with all back dues, to the Treasurer, *D. Blakeley Hoar, 220 Devonshire St., Boston, Mass.*

For the reasons above given, the trustees also appeal to the members of the corporation to send, with their annual dues, such further sums, however small, as the means and interest of each in the work may inspire. All contributions will be duly noted in the annual report, which is in course of preparation, and will be issued early in the coming year. A contribution of not less than $100 entitles the donor to a life membership, exempt from annual dues, or at his option, to nominate a person to occupy a private room in the Laboratory, free of charge, during one season. A contribution of $50 entitles the donor to a free scholarship, exempt from tuition fees, during one season. Contributions of smaller amounts will be gratefully received and duly acknowledged.

The forth-coming report will show fully all the recent changes in the organic law of the Association, and will be sent to all members in good standing.

By order of the Trustees,
H. C. Bumpus, *Secretary,*
Edward G. Gardiner, *Chairman,*
D. Blakely Hoar, *Treasurer,*
Camillus G. Kidder,
Henry F. Osborn, *President,*
James I. Peck, *Asst. Director,*
C. O. Whitman *Director,*
Executive Committee of Trustees.

All matters relating to the scientific administration of the Marine Biological Laboratory should be addressed to Prof. C. O. Whitman, University of Chicago, Chicago, Ill.; all applications for membership to the Secretary, Prof. H. C. Bumpus, Brown University, Providence, R. I.; all dues and subscriptions to the Treasurer, D. Blakeley Hoar, 220 Devonshire St., Boston, Mass.

Recent Appointments: Dr. Frech, professor of geology in the University of Breslau; Dr. Paul Samassa, professor extraordinary of zoology at Heidelberg; Dr. E. B. Copeland, assistant professor of botany in the University of Indiana, Bloomington, Ind.; Dr. G. Boccardi; associate professor of histology at the University of Naples; Ernest B. Forbes of the University of Illinois, assistant state entomologist of Minnesota; Dr. James E. Humphrey, associate professor of botany in Johns Hopkins University; Dr. George B. Shattuck, assistant in geology in Johns Hopkins University; Dr. Charles E. Beecher, advanced to University, professor of historical geology and Dr. L. V. Pirsson, professor of physical geology in Yale University; Miss Bertha Stoneman, professor of botany in the Huguenot College for Women in Cape Colony; J. L. Prevost, professor of physiology in the University of Geneva; Dr. J. J. Zumstein, professor of anatomy in the University of Marburg; Dr. H. Baum, professor of osteology in the Technical High School at Dresden; Dr. W. Ule, professor of geography in the University of Halle; Dr. A. O. Kihlmann, assistant professor of botany at Helsingfors; Dr. Alex. Bittner, chief geologist; G. Geyer, geologist, G. von Bukowski and August Rosiwál, adjunct, Drs. J. Dreger, F. von Kerner, J. J. Jahn and F. Eichluter, assistants of the imperial Austrian Geological Anstalt at Vienna; Dr. Karl Toldt, professor of anatomy, has been elected Rector of the University of Vienna for the coming year; W. Garstang, naturalist of the Plymouth (England) Laboratory; Dr. E. Kaufmann, professor of anatomy at Breslau; Dr. Max Walters, professor of anatomy at Bonn; W. H. Lang, lecturer in botany in Queen Margaret College, Glasgow; Dr. Walter Kruse, professor of hygiene at Bonn; Dr. Raphael Slidell, professor extraordinarius of zoology at Heidelberg; Prof. Johannes Ruchert, professor of anatomy in the University of Munich; Miss D. Clark, demonstrator in botany, Queen Margaret College, Glasgow; Freiher von Erlanger, professor extraordinarius of zoology at the University of Heidelberg; Dr. George J. Pierce, professor of plant physiology in Leland Stanford University; Miss M. Maclean, demonstrator in anatomy, Queen Margaret College, Glasgow; Prof. C. L. Herrick, lately professor of biology in Denison University, has been elected President of the University of New Mexico at Albuquerque; Miss Arma Anna

Smith, assistant in botany in Mt. Holyoke College; Prof. Ph. Stöhr, of Zürich, professor of anatomy in the University of Würzburg, Prof. von Kölliker restricting himself to histology and embryology; Prof. Hugo de Vries of Amsterdam, professor of botany in the University of Würzburg, as successor to the late Prof. Sachs; Dr. H. Fling, professor of biology and chemistry in the Oskosh Normal School; Dr. Bruno Hofer, director of the institute for the study of diseases of fishes at Munich; Henry Kraemer, professor of botany and microscopy in the Philadelphia College of Pharmacy; Dr. Albert Schneider, professor of botany in Northwestern University, Evanston, Ill.; Dr. Jumelle, assistant professor of botany in the faculty of sciences at Grenoble, France; Johannes Martin, Director of the Natural History Museum in Oldenburg; Dr. Philippi, assistant in the Museum of Natural History in Berlin; T. I. Pocock, assistant geologist on the British Geological Survey; Dr. W. F. Hume and L. Gorringe, assistants on the geological Survey of Egypt; Dr. H. V. Neal, professor of biology in Knox College, Galesburg, Ill.; Prof. George Ruge, to the chair of anatomy at Zürich, as successor to Prof. Stöhr; Dr. Ossau of Hiedelberg to the chair of mineralogy in Mülhausen; Dr. J. Büttikofer of Leiden, director of the zoological gardens at Rotterdam; Dr. Antoneo Crocicha, professor of biology in the Catholic University at Washington; Adolf Beck, professor of physiology at Lemburg; Dr. Ludwig Heim, professor ext. of bacteriology at Erlangen; Dr. H. Baum, professor of osteology at the Dresden Technical School; Dr. George Volkens, assistant in the Botanical Museum at Berlin; Dr. A. O. Kihlman, professor extraordinary of botany at Helsingfors; W. S. Boulton, of Mason College, lecturer in geology at University College, Cardiff, Wales.

James Ellis Humphrey, the son of James and Susan (Cushing) Humphrey, was born in Weymouth, Mass., August 5, 1861. He received his early education in the Weymouth schools, and at the early age of sixteen was appointed master of one of the grammar schools in his native town. Then after a short experience in the Prang Educational Company, he entered the Lawrence Scientific School of Harvard University, from which he received the degree of S. B. in 1886. During his college studies he paid especial attention to botany, and immediately upon graduation he received an appointment as assistant in the botanical laboratories under Professor G. L. Goodale In 1887 he was appointed instructor in botany in the University of Indiana, and the next year he accepted the position of botanist in the State Agricultural Experiment Station at Amherst, Mass., where he remained until 1892. While at Amherst he continued his studies under

the direction of the Harvard Faculty, and in 1892 received the degree of Sc. D. from his alma mater. This same year he spent three months in Jamaica collecting botanical material. He then went to Germany where he studied until 1894 under Professor Edouard Strasburger at Bonn. Upon his return to America he was made a fellow in the Johns Hopkins University, and the next year received an appointment as lecturer in botany in that institution. This present year he was advanced to the position of associate professor of botany. In early June, he sailed with a party of Johns Hopkins students to Jamaica, where the Johns Hopkins marine laboratory was established for the summer. The work was most successful and Professor Humphrey obtained some most important material upon the embryology of the palms and of ginger. On August 12 he was taken sick, but his condition was not considered at all serious until the 17th, when he rapidly grew worse, dying the same day of pernicious malarial fever.

Early in his botanical career, Dr. Humphrey became interested in the study of the Algae, and his first-published paper (his thesis for the degree of S. B.) was on the development of the frond of *Agarum turneri*, in which he explained the method by which the peculiar perforations found in that species are formed.

Upon his removal to Indiana and later to Amherst, it became necessary to pay especial attention to the fungi, and more particularly to those which cause plant diseases. His reports as botanist to the Amherst Experimental Station include valuable papers on the black-knot of the plum, on diseases of cucumbers and potatoes, and on other kindred diseases. More important and more elaborate than these was his dissertation for the doctor's degree, a monograph of the Saprolegniaceæ, which will long remain a classic upon this subject.

Naturally, upon his introduction to Strasburger's laboratory, his studies took a cytological turn and his several papers upon the cell and cell-contents were published in the *Berichte* of the German Botanical Society and in the *Annals of Botany*. For many years he furnished abstracts of American botanical work for the *Botanische Centralblatt*, and he also translated and edited Zimmermann's "Botanical Microtechnique."

Personally, Dr. Humphrey was straightforward and outspoken, and little inclined to tolerate what seemed to him inferior work. The work he had already done showed what might have been expected of him in the future, connected with a university with whose scientific staff he was in full sympathy, and upon whose students his enthusiasm and his sincerity were already producing happy results. He was very optimis-

tic and had the happy faculty of believing that the future would turn out well, whatever the discouragements of the moment.

To his older botanical friends his sudden death at an age when so much was hoped from him for years to come, is a great shock, and they recall vividly his many sterling qualities as well as his capacity as a botanist. To us, connected editorially with the AMERICAN NATURALIST, his loss is a severe one, as he had made all arrangements to act as one of the editors of this magazine.

Recent deaths: Dr. Alfred Stocquart, chief demonstrator of anatomy in the University of Brussels; Dr. Legros, professor of physiology in the same university; H. V. Carter, professor of anatomy and physiology in Grant College, Bombay; E. Russow; former professor of botany at Jurjiew, April 23d, aged 56; Lucien Biart, naturalist and collector, in Mexico; L. Jurani, professor of botany in the Royal University of Hungary, Feb. 27th, aged 59; C. J. M. Bugnion, entomologist, at Lausanne, Jan. 19th, aged 86; Mrs. Alice Bodington, a well-known contributor to the American Naturalist, at New Westminster, British Columbia; H. D. Achon, coleopterist, at Orleans; Leon du Pasquier, professor of geology and paleontology in the Neuchatel Academy, in April, aged 33; V. Maurice Teinturier, coleopterist, in Clayeures, France; Madame Jean Dollfus, editor of *La Feuille des jeunes Naturalistes;* Edmund Neminar, formerly professor of mineralogy and petrography in the University of Innsbruck; Victor Lemoine of Rheims, paleontologist; Karl Kolbel of the Vienna Hofmuseum, student of Arthropods, at Ponape, Caroline Islands; Alexis Jordan, botanist, at Lyons, France, Feb. 7th, aged 83; J. B. Hodgkinson, entomologist, Ashton on Ribble, England, Feb. 17th, aged 73; Fr. Wilh. Klatt, botanist, at Hamberg, March 3rd; Geo. W. Traill, marine algologist: Alex. N. Kortschagin, curator of the zoological museum at Moscow, Feb. 7th; Alfred Dewevre, botanist, Feb. 27th in Congo State; Friederick Seelig, ichthyologist, in Cassel, March 18th; Prof. Hermann Friederich Kessler, student of Aphides, in Cassel; Hugh Nevill, collector and naturalist, at Hyères, France, April 10th; Heinrich Waukel, Anthropologist, in Olmutz, aged 76; Emile Magitot, President of the Anthropological Society of Paris; Joseph Ewing Macfarland of the U. S. Geological Survey, in Baltimore; Sir Augustus Wollaston Franks, a well-known archæologist and trustee of the British Museum, May 21st, aged 71; W. Preyer, professor of physiology, at Wiesbaden, aged 56; Professor Chudzinski of the Paris School of Anthropology; Frederick C. Straub, botanical collector in Liberia, Africa, March 21st, aged 26; Sir John Bucknell, neurologist, at Bournemouth,

England, July 20th, aged 79; Dr. J. Hammond Trumbull, student of American linguistics, at Hartford, Conn., Aug. 5th, aged 76; Capt. Bertram Lutley Sclater, African explorer, son of P. L. Sclater, at Zanzibar, July 24 aged 31; Dr. Alfred Moquart, professor of anatomy at Brussels on June 5th; Count Victor Trevisan, cryptogamist in Milan, April 8th.

For many years we have heard tales from the southwest regarding the "Enchanted Mesa" which in brief were to the following effect. Many years ago this table-land was inhabited by a tribe of Pueblo Indians, but a sudden catastrophe rendered the top of the mesa no longer accessible. To investigate this legend was one of the objects of Professor Libbey in his recent trip to New Mexico and we summarize the results of his ascent of the Mesa Encantada from the dispatches in the daily papers. The ascent was made July 23, 1897 and was successful in every respect. Ropes were thrown over the mesa by means of a cannon borrowed from the Life-Saving Service of the U. S. Government and by means of a boatswains chair the party were hauled to the top, 550 feet above the surrounding plain. The level top was about fifteen acres in extent, its sides being precipitous. No traces, whatever of former human habitation were found, the legend apparently being without any foundation. Here, however, there is room for a difference of opinion. In *Science*, for September 17, "W. S. M.," whose initials will readily be recognized, states that on September 3, 1897, Mr. F. W. Hodge, of the Bereau of Ethnology, scaled the mesa and found fragments of pottery, two broken stone axes, a stone arrow point and some other evidences of former occupancy.

Col. Theodore Lyman died at Nahant, Mass., Sept. 9, 1897. He was born at Waltham, Mass., Aug. 23, 1833, graduated at Harvard in 1855, and then spent three years in study under the late Professor Louis Agassiz. He served in the Union Army from 1863 to the close of the war. In 1865 he was appointed Commissioner of Fisheries in Massachusetts, a position which he held for 17 years, and in 1882 he was elected a representative in Congress. He was connected with many educational and philanthropic interests. In zoology he was largely interested in Echinoderms, and published several important papers upon the Ophiuroids, his chief work in this line being the large monograph of 400 pages and 48 plates in the Results of the "Challenger Expedition." For more than ten years he had been an invalid.

From *Science* we learn that the Berlin Academy of Sciences has made the following subsidies for scientific work. Prof. F. E. Schulze,

to aid in the publication of Das Theirreich, Mk. 35,000; Prof. Engler, for publication of monographs on African botany, Mk. 2000; Dr. G. Lindau, for studies on lichens, Mk. 900; Prof. F. Frech, for geological studies, Mk. 1500; Prof. H. Hürthle, for studies on muscles, Mk. 850; Prof. R. Bonnet for work on blood vessels, Mk. 800; Dr. Lühe, study of the fauna of the salt lakes of Northern Africa, Mk. 2000; Dr. G. Brandes for studies on Nemertines, Mk. 300; Dr. R. Hesse for studies on eyes of lower invertebrates, Mk. 500; Prof. E. Cohen, study of meteorites, Mk. 1500; Dr. L. Wulff, for experiments on artificial crystals, Mk. 1500.

The first number of the Zoological Bulletin, edited by Whitman and Wheeler has appeared from the press of Ginn & Co., Boston. It contains four articles: E. P. Allis on the petrosal and sphenoid regions of Amia; C. W. Hargitt, experiments on regeneration in Cœlenterates; C. L. Bristol, the metamerism in Nephelis, especially as shown by the nervous system; G. Baur, a criticism and reply to the recent paper by Bumpus in so far as the latter denies the probability of the intercalation of vertebræ. The Bulletin is gotten up in the same shape as the Journal of Morphology. It is to be issued six times a year, each number containing at least fifty pages. The subscription price is $3.00 per annum. The title page gives a list of 73 well-known names as collaborators.

The Academy of Sciences of Berlin, offers a prize of 2000 marks for the best memoir upon the origin and characteristics of the different cereals during the past twenty years. The memoirs which may be written in German, Latin, French, English or Italian, must be submitted to the Academy on or before December 31, 1898. Another prize of 1000 marks, is offered by the Prince Jablonowski Society of Leipzig for the best memoir on the causes which produce and control the direction of the lateral axes of shoot and root systems of plants. The competing memoirs are due on or before November 30, 1900.

Dr. Franklin Story Conant died in Boston, Sept. 13, of pernicious malarial fever. He was a graduate of Williams College, and had just received the degree of Ph. D. from Johns Hopkins' University, as well as the appointment to the Adam T. Bruce Fellowship in that institution. He accompanied the Johns Hopkins party to Jamaica this summer, and was taken sick on the return voyage. Dr. Conant's only published work was upon the Chætognaths, but he had other and important papers nearly ready for the press.

An expedition started from Sydney, Australia on June 2d, to bore into the coral reef of Funafuti. The expedition is supported by the mining department of the New South Wales government and by private subscriptions. In the light of the recent similar expedition of the Royal Society we cannot but think that they would have done well to have put the practical work of boring in the hands of an American familiar with the boring of gas and oil wells.

We would call the attention of those purists in terminology who would replace such names as Ellobius, Gymnura, Gyge, etc., because of similarity to Ellobium, Gymnurus, Gyges and the like to the advisability of changing Raja, Iza and similar names because of possible confusion with words like Rana, Ixa, etc. This seems to have been neglected by them in their attempts to introduce confusion into nomenclature.

Plans have been drawn for two additions to the American Museum of Natural History in New York City. One addition is for a lecture hall at the north end of the present structure to cost $150.000; the other a six-story addition to the west wing at an estimated cost of $400.000.

On July 6th Professor Albert von Kölliker celebrated his eightieth birthday and his fifty year jubilee as ordinary professor of anatomy. He was presented with an album with carved ivory and ebony covers containing the photographs of hundreds of scientific men.

The tenth annual winter meeting of the Geological Society of America will be held at McGill University, in the city of Montreal, on December 29, 30 and 31, 1897. Details of the meeting will be announced in a circular to be issued about November 1.

Dulau and Co. of London, have issued an album of half tone portraits of the Collaborators of the Scientific Reports of the Challenger Expedition arranged on nineteen plates. The edition is limited to 200 copies and is sold at 12s. 6d.

The Geological Survey of India, is engaged in investigating the recent earthquake near Calcutta in the most thorough manner, every available assistant being detailed to study some aspect or some locality.

The Vienna Academy of Sciences recently celebrated the fiftieth anniversary of its foundation. The government grant to the Academy has been increased from $16,000 to $20,000 yearly.

Mr. Alexander White has received the silver medal of the Zoological Society of London in recognition of his zeal in making large botanical and zoological collections in Nyassaland.

Professor A. P. Karpinski has resigned from the chair of geology in the Mining Institute at St. Petersburg and Dr. Ivan V. Muschketoff has been elected his successor.

The Woodwardian Museum of Cambridge, England, has received the geological library of Prof. Thomas Wiltshire. It contains about 600 volumes and 900 pamphlets.

Prof. Raphael Blanchard, of Paris, will begin the publication of a new journal the Archives de Parasitologie, the first number of which will appear in January.

The meeting of the German Zoological Society next spring will be held at Heidelberg. There was a total attendance of 50 at the meeting at Kiel this year.

The Deutsche Botanische Gesellschaft met this year at Brunswick, September 21 as a section of the Versammlung Deutscher Naturforscher und Arzte.

The Hopkins Marine Biological Laboratory at Monterey, California, is the subject of an article by Dr. Bashford Dean in *Natural Science* for July.

Dr. Zwaardemaker of Utrecht, has received the Tilanus gold medal from the University of Amsterdam for his work on the physiology of smell.

In the Imperial College of Science at Tokyo, there are 89 students. Of these 12 are taking Botany and Zoology and 14 are taking Geology.

Professor Virchow has been elected a foreign associate of the Paris Academy of Scienes in the place of the late Dr. Tchebitchef.

The German Anatomical Society will meet next year in April at Kiel. At its meeting in Ghent this year fifty were present.

Professor Wilhelm His has received the degree of Doctor of Philosophy, *honorio causa*, from the University of Leipzig.

The Prussian government will assist the fresh-water biological station at Plön after October, 1898.

The Zoological Gardens of Amsterdam, are described in *Macmillan's Magazine* for July.

Prof. R. Leuckart has been made a knight of the Prussian Order of Merit.